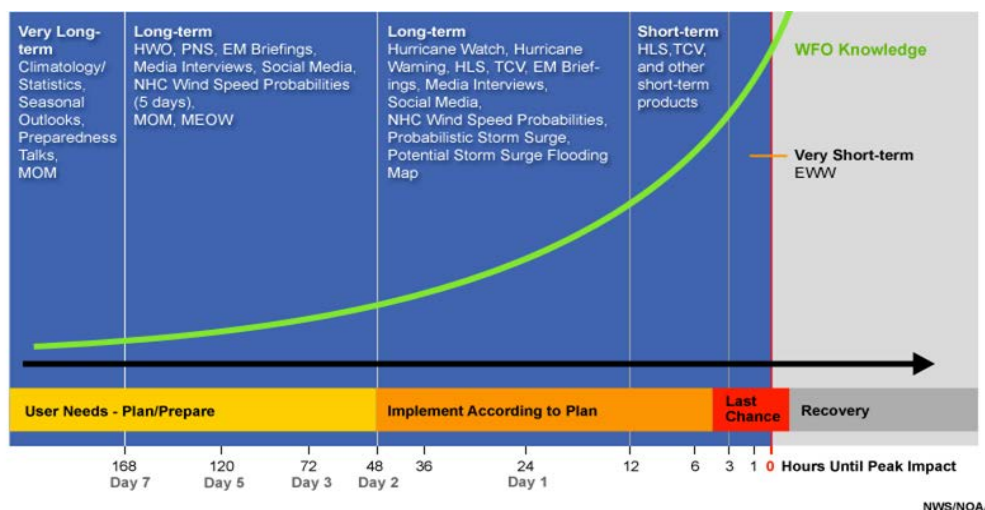8-2019

NRPT: Learning from the Past and Moving Forward: Response Challenges from Severe Weather or Tsunamis to Shared Trust Resources and Mission Responsibilities

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NOAA REGIONAL PREPAREDNESS TRAINING (NRPT): PUERTO RICO

Learning from the Past and Moving Forward: Response Challenges from Severe Weather or Tsunamis to Shared Trust Resources and Mission Responsibilities

This workshop is a partnership between NOAA's Gulf of Mexico Disaster Response Center and the Disaster Preparedness Program with the Coastal Response Research Center.

I. Acronyms

AST	Atlantic Standard Time
(B)EOC	(Business) Emergency Operation Center
CARICOOS	Caribbean Regional Association for Coastal Ocean Observing
CERT	Community Emergency Response Team
COA	Course of Action
CRRC	Coastal Response Research Center
CTWP	NOAA NWS Caribbean Tsunami Warning Program
CWA	Cyclone Watch Area
DNER/DRNA	Puerto Rico Department of Natural and Environmental Resources (Spanish=DRNA)
DOI	U.S. Department of the Interior
DPP	Disaster Preparedness Program
DRC	NOAA's Gulf of Mexico Disaster Response Center
EAS	Emergency Alert System
EMS	Emergency Management System
EOC	Emergency Operations Center
ESF	Emergency Support Function
EWW	Extreme Wind Warning
FEMA	U.S. Federal Emergency Management Agency
GOM	Gulf of Mexico
GSA	U.S. General Services Administration
HHW	Household Hazardous Waste
HLS	Hurricane Local Statement
IDSS	Impact-Based Decision Support Services
IOOS	Integrated Ocean Observing System
IOC	Intergovernmental Oceanographic Commission of UNESCO
IPaC	U.S. Fish and Wildlife Service Information for Planning and Consultation
ISER-Caribe	Institute for Socio-Ecological Research, Inc. – Caribbean
JFO	Joint Field Office
MEOW	Maximum Envelop of Water
MER	U.S. Coast Guard Marine Environmental Response
MOM	Maximum of MEOW
NARA	The National Archives and Records Administration
NCR	Natural and Cultural Resources
NEA	National Endowment for the Arts
NEH	National Endowment for the Humanities
NESDIS	National Environmental Satellite, Data and Information Services
NFWF	National Fish and Wildlife Foundation
NGO	Non-governmental organization
NHC	National Hurricane Center
NMEAD	Negociado para el Manejo de Emergencias y Administracion de Desastres (The Bureau of Emergency Management and Disaster Management of the Department of Public Safety)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service

NRPT	NOAA Regional Preparedness Training
NRT	National Response Team
NWS	NOAA National Weather Service
OEM	Office of Emergency Management
OFA	Other Federal Agencies
OR&R	NOAA Office of Response & Restoration
PA System	Public Announcement System
PPAPG	FEMA Public Assistance Program Policy Guide
PSMA	Pre-Scripted Mission Assignments
PRASA	Puerto Rico Aqueduct and Sewer Authority
PREMA	Puerto Rico Emergency Management Agency
PRSN	Puerto Rico Seismic Network
PTWC	Pacific Tsunami Warning Center
RRF	Resource Request Form
RSF	Recovery Support Function
RSS	Rich Site Summary and Really Simple Syndication (respectively) is a type of web feed which allows users and applications to access updates to online content in a standardized, computer-readable format.
SJFO	San Juan Forecast Office
TCV	Tropical Cyclone Watch/Warning
TWC	Tsunami Warning Center
TWFP	Tsunami Warning Focal Point
UPR	University of Puerto Rico
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
UNESCO	United Nations Educational, Scientific and Cultural Organization
USEPA/EPA	U.S. Environmental Protection Agency
USCG	U.S. Coast Guard
USVI	U.S. Virgin Islands
VHF	Very High Frequency
VITEMA	Virgin Islands Territorial Emergency Management Agency
VTEC	Valid Time Event Code
WEA	Wireless emergency alerts
WFO	Weather Forecast Office
WWTP	Wastewater treatment plant

II.   Acknowledgements

This workshop and report were supported by the National Oceanic and Atmospheric Administration's Disaster Preparedness Program (DPP) and the University of New Hampshire's Coastal Response Research Center (CRRC). The content for the workshop was developed in cooperation with NOAA's Gulf of Mexico Disaster Response Center and the following Organizing Committee members:

- Nancy Kinner, Coastal Response Research Center, University of New Hampshire
- Charlie Henry, NOAA Gulf of Mexico Disaster Response Center
- Christa von Hillebrandt-Andrade, NOAA National Weather Service, Caribbean Tsunami Warning Program
- Roberto Garcia-Hiraldo, NOAA National Weather Service, San Juan Weather Forecast Office
- Sean Griffin, NOAA Restoration Center
- Jennifer Koss, NOAA Coral Reef Conservation Program
- Lisamarie "Lee" Carrubba, NOAA Fisheries, Office of Protected Resources

This workshop was facilitated by Dr. Nancy Kinner from the Coastal Response Research Center (CRRC; www.crrc.unh.edu). CRRC is known for its independence and excellence in areas pertaining to environmental engineering, marine science and ocean engineering as they relate to oil spills. The Center has widespread experience working with disaster preparedness and hazardous spill-related issues. CRRC has conducted 60+ workshops that bring together practitioners, researchers, and scientists of diverse backgrounds (e.g., industry, academia, government, NGOs).

We would like to thank each of the presenters for their participation in the workshop:

- Carmen R. Guerrero-Perez, Director of the Caribbean Environmental Protection Division (Lessons Learned following Hurricane Maria)
- Ernesto Rodríguez, NOAA National Weather Service, San Juan Weather Forecast Office (Learning from the Past, Improvement for the Future)
- CAPT Ricardo Alonso, USCG MER (Mission Response)
- Charlie Henry, NOAA Gulf of Mexico Disaster Response Center (Introduction to NOAA's Disaster Preparedness Program)
- Jennifer Koss, NOAA Coral Reef Program (NOAA Caribbean Overview, Mission Response)
- Jose Marchand, FEMA Capacity Building Sector (FEMA Capacity Building Sector)
- Debra Payton, U.S. Department of the Interior (DOI) (Responsibilities, Efforts and Lessons Learned for Natural and Cultural Resources (NCR) Recovery Support Function (RSF))
- Carlos Huertas-Hernandez, EPA, On-Scene Coordinator (EPA Response Perspective)
- Ernesto Diaz, DNER (Lessons Learned)
- Carlos Irigoyen Gonzalez, Puerto Rico Emergency Management Agency (PREMA) (Lessons Learned & Risk Communication)
- Christa von Hillebrandt-Andrade, NOAA Tsunami Center (Tsunami Mission, Products and Protocols)
- Ernesto Morales, NOAA National Weather Service, San Juan Weather Forecast Office (NWS Weather and Forecast Products for Decision-Makers)

- Mirelsa Modestti Gonzalez, Sagrado Corazón University (Social Media Tips)

Thank you to Christa von Hillebrandt-Andrade, Carolina Hincapié, Ernesto Rodríguez and Odalys Martinez for organizing and facilitating the tsunami and hurricane preparedness training that took place on the final day of the workshop.

A special thanks to (1) the Breakout Group Leads: CAPT Ricardo Alonso, Debra Payton, Charles Grisafi, Charlie Henry and Jennifer Koss; and (2) Kathy Mandsager, Jesse Ross, Zak Mandsager and Melissa Gloekler for their note-taking during the workshop.

We greatly appreciate the U.S. Environmental Protection Agency (EPA), Caribbean Environmental Protection Division in Guaynabo, Puerto Rico for their hospitality and providing an excellent meeting venue.

III.   Introduction

On April 23-25th, 2019, CRRC and DPP co-sponsored a National Oceanic and Atmospheric Administration (NOAA) Regional Preparedness Training (NRPT) Workshop at the USEPA facility in Guaynabo, Puerto Rico. The workshop, titled "*Learning from the Past and Moving Forward: Response* Challenges from Severe Weather or Tsunamis to Shared Trust Resources and Mission Responsibilities*", focused on preparedness, planning and improving response to an extreme weather event or natural disaster.

*For the purpose of this workshop, the term "response" includes a continuum from emergency response activities through recovery activities.

Forty-five participants (Appendix B) represented federal, commonwealth and local agencies, academia, and industry.

This was the fourth workshop in a series of NRPT events, the goal of this workshop is to provide focused discussion regarding lessons learned from hurricane and natural disaster response for specific regions. NRPT workshops are conducted to improve preparedness and build a common understanding of how disasters can be addressed when they threaten personnel, infrastructure or natural resources. This program uses NOAA resources to address localized problems and concerns with respect to emergency preparedness and planning. The focus of the workshop was improving preparedness- through communication, logistics and building relationships/planning season for the Caribbean region (e.g., Puerto Rico, U.S. Virgin Islands) following the 2017 hurricane.

Workshop Objectives:

1. Improve knowledge and skills to enhance risk communications before and after a damaging or disastrous tropical hurricane (cyclone) or tsunami event.
2. Apply lessons learned to "disaster readiness" for safety of staff and families as well as shared trust resources.
3. Enhance effective mission response and recovery activities.
4. Build resilient local coastal communities on the islands through preparedness planning to: (a) gain knowledge, (b) enhance cross-agency and cross-regional coordination, and (c) foster response/recovery planning and informed actions.

Workshop Goals:

1. With adequate information and communicated knowledge, the public and response community will make informed decisions relative to personal protection and safety.
2. With adequate information and effective communications, responders and natural resource managers are prepared for and respond effectively to mitigate disaster impacts.

The workshop consisted of plenary presentations, three breakout group discussions and two table-top exercises. The first two days included plenary presentations from local and federal emergency responders outlining organization missions and responsibilities, lessons learned from the 2017 hurricane season and improvements for the future. A summary of the presentations can be found *Section III "Plenary Presentations"*, slides are located in Appendix C.

Participants were split into four breakout groups (Groups A-D), and remained in these same groups for all three of the breakout group discussions. Breakout groups were tasked with: (1) identifying lessons/practices/skills learned from the plenary presentations, (2) highlighting actions to improve/put into practice the previously identified "lessons learned", and (3) recommend actions for implementation. The third day consisted of two table top exercises, the first was on tsunami preparedness and planning, and the second focused on hurricane emergency response planning and preparedness.

The agenda for the workshop can be found in Appendix A.

IV.   Plenary Presentations

Day 1 – April 23, 2019

Carmen Guerrero-Perez, Director of EPA Region 2's Caribbean Environmental Protection Division, discussed lessons learned with respect to terrestrial and marine chemical spills and response following Hurricane Maria. Director Guerrero-Perez drew specific attention to the quantity of disaster debris generated and removed (e.g., approximately 12 million cubic yards of debris, 52% construction debris and 44% vegetative debris) and the management of household hazardous wastes (HHW) (e.g., 322,148 HHW containers in Puerto Rico, 145,575 HHW containers in USVI). Following the hurricane, 22 of 51 wastewater treatment plants (WWTP) in Puerto Rico were out of service, three WWTPs completely flooded, and 222 of 714 pump stations were out of service.   Out of service facilities and infrastructure resulted in sewage overflows into surface and coastal waters. Coastal flooding was also exacerbated due to inoperable stormwater management systems. In order to protect public health and determine environmental conditions post hurricane, the restoration of the water- and air-quality monitoring networks were a priority in the emergency response.

There were many pre-existing conditions that were exacerbated by the hurricanes. Examples of these include: the fiscal situation, deterioration of infrastructure, lack of maintenance and resources, history of non-compliance, threats from extreme weather and natural disaster events (e.g., hurricanes, drought, precipitation, sea level rise, salinity intrusion to aquifers).

Director Guerrero-Perez discussed methods to move forward and improve disaster preparedness and planning. The first recommendation emphasized the need for continuous improvement because "being

prepared is not a one-time effort". In order to do this, multisector and multidisciplinary engagement is needed to clarify roles during a response and improve emergency preparedness. Stakeholders for a multisector approach include local government (e.g., DNER, PREMA), Federal government (e.g., NOAA, DOI, USCG, FEMA, USACE, USEPA), academia (e.g., UPR, Sea Grant, CARICOOS, PR Seismic Network, etc.), NGOs (e.g., Para la Naturaleza, Foundation for Puerto Rico, ISER-Caribe) and the private sector. The second take-away message was focusing on emergency management plans, specifically on pre-selected locations for temporary staging areas, pre-agreements with municipalities, waivers and permit pre-approvals with local and federal agencies. Third, was leveraging resources allocated by the federal government and disaster recovery plans to avoid duplication of efforts. Finally, she recommended focusing on risk communications before, during and after an extreme weather event/natural disaster to minimize public health impacts and coordinate a successful emergency response.

Ernesto Rodríguez, NOAA NWS, introduced the mission and vision outlined by the NWS. The mission is to provide weather, water and climate data forecasts and warnings for the protection of life and property and the enhancement of the national economy. Preparation for the hurricane season is a year-long event, which requires building trust between emergency response organizations to minimize stress during actual events. NWS employees meet with decision makers to work through various tabletop exercises, full-scale exercises and outreach activities. There are pre-event coordination meetings conducted with island commonwealth, local governments and federal agencies that include briefings and information sharing sessions. Core partners (e.g., PREMA) use information provided by NWS to make critical decisions; exercises and briefings provide a venue for NWS to teach partners how to correctly interpret information, weather maps and forecasts.

NWS also coordinates internal meetings to update graphic outputs to be more user friendly, answer questions asked by decision makers, and discuss the best ways to tailor information with respect to region. Internal coordination meetings allow NWS to be on the same page in case one office needs to cover for another other during an emergency event. This occurred in 2017; the Miami office was in charge of day-to-day work when the San Juan office was supporting the Emergency Operations Center (EOC) following Hurricane Maria.

The highlighted lessons learned were: (1) the need for back-up communication in the event of a disaster, (2) the realization that not all tools will be available following a catastrophic event, and (3) contingency planning including multiple back-up NWS offices outside of threat zone to act as support offices.

CAPT Ricardo Alonso, USCG Marine Environmental Response (MER), focused on the USCG's mission response and the role of the Coast Guard during a response operation. The National Response Team (NRT) is activated in the event of oil or hazardous substances discharge, transect national boundaries, or threatens public health, property, or natural resources. CAPT Alonso stressed the importance of good communication and understanding the framework for how the federal government operates in an emergency. He also recommended that all response organizations read the overarching regulatory authority (e.g., 40 CFR 300 National Contingency Plan), and know the functions (e.g., roles and responsibilities) of each organization and personnel when responding to a disaster. Although preparedness is a slow and tedious process, it is the most important piece when saving lives. Preparedness planning needs to be done both internally (e.g., local, district, families) as well as externally (e.g., area contingency plans). The local and regional scale should include tabletop and

hands-on exercises (e.g., pre-staging equipment) to identify weaknesses and gaps prior to a disaster. Exercises should also encourage interaction between stakeholders, opening early lines of communication and introducing critical players.

CAPT Alonso documented five key points: (1) USEPA and USCG coordinate and direct the response, USEPA for inland areas and USCG for the coastal zone; (2) other federal agencies with appropriate jurisdiction and expertise support the lead agency; (3) activities are done in partnership with state/commonwealth and local officials; (4) industry is responsible for being prepared for, responding to, and paying for cleanup and damages from pollution incidents when they are designated the primary responsible party; (5) the NRT uses the National Incident Management System/Incident Command System to bring these parties together to manage response actions.

Throughout the presentation, four response and recovery challenges were identified: (1) interagency coordination, (2) the ability to rapidly set-up communications for interagency coordination, (3) response dependent upon logistics, surge forces and equipment, and (4) infrastructure critical for survivors and responders.

Major lessons learned following recent hurricane responses include: (1) issues identified with respect to USCG flood response assets (e.g., equipment, communication); (2) satellite phones capable of placing and receiving calls should be used during response operations; and (3) additional internet technology support should be on-hand during a disaster. A more general summary of lessons learned that can be applied to an array of agencies consist of: (1) use of resources to enhance alignment with partner agencies' goals; (2) use of Flood Punt Teams to conduct urban Search and Rescue; (3) Emergency Support Function (ESF)-10 and mission assignment training; (4) training of unmanned aircraft system; (5) plan for and execute exercises spanning across multiple districts; (6) ensure personnel support teams are adequately staffed to manage call volume for accountability of CG members an family; and, (7) continually engage with external agencies pre and post hurricane season, as well as leverage relationships during event.

Jennifer Koss, Director of the Coral Reef Conservation Program at NOAA, gave an overview of NOAA's presence in the Caribbean, including NOAA's role as a science based organization to provide the best available science when assisting decision makers. Additionally, NOAA NWS/NOS keeps citizens aware of any climate and weather related changes, help with fisheries management, and provide support to fisheries commerce. With respect to response organizations, NOAA maintains the NWS Caribbean Tsunami Warning Program (CTWP), the National Hurricane Center (NHC), the National Marine Fisheries Service (NMFS), National Ocean Service (NOS), the Integrated Ocean Observing System (IOOS), Sea Grant and the National Environmental Satellite, Data and Information Service (NESDIS).

Following Hurricane Maria, there were mission assignments through FEMA to conduct coral restoration. FEMA and NOAA/NFWF reattached over 17,000 corals at 70+ field sites and surveyed over 400,000 m^2 of reefs. This was the first ever mission assignment FEMA authorized for coral assessment and triage work; it was recognized by FEMA that coral reefs are the first line of defense to reduce storm related impacts (e.g., storm surge, wave energy).

Charlie Henry, NOAA OR&R DPP, noted all of the line offices in NOAA have a role in disaster response. The FEMA pre-scripted mission assignments assigned to NOAA's National Ocean Service (NOS) include: coastal science support coordinator, geodetic surveys, aerial imagery/LIDAR,

hydrographic surveys, scientific support for oil and chemical spills, and marine debris assessment. If there are other needs or requests by FEMA for NOAA support (e.g., recovery functions) additional and new missions can be assigned. NOAA OR&R's mission is to provide world-class science and information-based solutions to protect and restore the nation's resources and their uses from coastal environmental hazards. The Disaster Response Center (DRC) was established as a hub in the Gulf of Mexico (GOM) which serves as the center for emergency preparedness and response in the case of a disaster/environmental hazard.

Jose R. Marchand-Parnell, FEMA Acting Deputy Director for the Capacity Building Sector of FEMA noted the main challenge when responding to Hurricane Maria was the lack of preparation, better preparedness supports a faster recovery. The FEMA mission was to provide essential support, guidance and tools to the whole community including federal, commonwealth, municipal, private sectors and NGO partners. To build upon, restore and strengthen their capability and capacity as entities and individuals, to be prepared and able to perform their essential functions effectively, efficiently, and sustainably in response and recovery efforts. The core partners that FEMA worked with during recovery included the Puerto Rico Emergency Management Agency (PREMA), Puerto Rico Planning Board and 78 local Emergency Management Offices. The programs/units that fall under recovery include: community resiliency/preparedness, continuity of operations, training and exercise, mass care, and others.

Mr. Marchand outlined major innovations/lessons learned: (1) The need for assessing current capabilities of local communities to determine their level of preparedness when responding to a disaster. If preparedness seems to be inadequate, then teaching communities and providing technical advice to improve the baseline knowledge level is essential. Outreach programs include, the FEMA lifelines situational reporting integration which was developed to ensure response is coordinated in the same manner regardless of language, background to ensure that all communities are on the same page when preparing for an event. The initiation of the Youth Preparedness Council provides in-school learning opportunities to practice preparedness, and spreads knowledge through community outreach and projects. Another outreach program is through the Core Advisory Groups; these are made up of community volunteers and different NGO's throughout the island, working with various planning tools, whose goal is assessing and identifying population needs that should be accounted for during a response, and to ensure disability integration throughout all emergency planning phases. (2) The establishment of the Business Emergency Operation Center (BEOC) that involves private businesses in planning and response stages. In the past, engagement with private businesses was limited, but it is a valuable asset during a response. (3) The need to work with academia to engage local colleges and universities in developing an emergency management curriculum to encourage students to think of it as a career path. (4) The need to minimize the high employee turnover rate within local organizations and improve the flow of information for new employees. In order to keep people prepared, continuous training of employees is necessary.

Debra Payton, Department of Interior (DOI) noted that FEMA operates as a coordinating agency following five frameworks associated with disasters: prevention, protection, mitigation, response and recovery. Following Hurricane Maria, DOI is supporting FEMA as the Natural and Cultural Resource coordinator under the Recovery framework. DOI's mission is to protect natural and cultural resources and historic properties through appropriate actions to preserve and restore them consistent with post-disaster community priorities and best practices, and in compliance with applicable environmental and historic laws and orders. This objective is delivered through the Natural and Cultural Resources (NCR)

Recovery Support Function (RSF) which encompasses primary agencies such as DOI, NOAA, USEPA and FEMA and several supporting agencies. There are many classifications of cultural resources, including archeological sites, buildings and structures, landscapes, burial sites, objects/collections/records. Additionally, DOI focuses on protection and restoration of natural resources, which includes wildlife, vegetation, land, water (e.g., salt and fresh, surface and groundwater, drinking, irrigation), and recreational sites.

The effort to restore damaged natural and cultural sites begins through a series of assessments. Following Hurricane Maria, DOI conducted over 40 different types of assessments. It was imperative to do the work upfront because it is hard to capture the devastation once restoration begins. The initial assessments resulted in courses of action (COAs); there are a total of 276 COA's that were in the governor's report. NCR "owns" 22 of those COAs. COA development was supported by many agencies and partners (e.g., DOI, NOAA, EPA, USDA, NEA, GSA, NEH, NARA, the Commonwealth, UPR and NGOs), and was conducted by using Solutions Based Teams. Solution Based Teams can identify solutions to COAs, provide advice/recommendations and expertise to the Commonwealth, provide the Commonwealth assistance in prioritizing projects, determine/suggest appropriate sources of funding, and provide technical assistance in scoping projects. Most resources under NCR do not qualify for FEMA funds. Therefore, the next step after assembling the COAs is to identify potential funding sources and/or partnerships to move projects forward (e.g., public/private partnerships, grants, Federal Agency supplemental funds, NGOs, philanthropic sources).

The lessons learned from the perspective of DOI included: (1) the scope of potentially impacted resources is difficult to determine initially and damages may not be known upfront; 18 months later there are still a few assessments that are underway, (2) in tropical areas, downed wood is not necessarily debris, (3) application of FEMA's Public Assistance Program Policy Guide (PAPPG) for non-traditional natural features is complex, and (4) it is important to be bold when conducting initial assessments.

Carlos Huertas-Hernández, U.S. Environmental Protection Agency (EPA), noted that during a declared disaster response, the USEPA operates under "Emergency Support Function #10: Oil and Hazardous Materials Response" of the National Response Framework. Under this function, USEPA provides personnel to assist FEMA and other EOCs in response operations. Additionally, USEPA is responsible for removal, cleanup and disposal of oil and hazardous materials. This includes collection and disposal of household hazardous waste (HHW) and monitoring immediate threats to public and environmental health and safety in Puerto Rico and the U.S. Virgin Islands. Following Hurricane Maria, USEPA was also tasked with drinking water monitoring in the U.S. Virgin Islands, repairing ambient air monitoring stations in Puerto Rico and providing emergency power to non-PRASA systems in Puerto Rico. Coordination and execution of all necessary assessments, evaluations, sampling and analytical services/support was performed by USEPA employees to ensure the safety and quality of drinking water and wastewater systems in Puerto Rico.

These tasks brought to light a number of challenges/lessons learned, which included: (1) difficulties/delays in transporting personnel and equipment into Puerto Rico and the U.S. Virgin Islands via flights and barges, (2) many responders were not Spanish speakers, but local translators were (success story), (3) USEPA coordinated the segregation, transportation and disposal of all oil and hazardous substances collected under ESF#10 by both USEPA and USCG, (4) equipment was held up in

U.S. Virgin Island ports due to demands for tax payments, (5) equipment was held in the continental U.S. /hard to get on a barge because of low priority compared to food or water (i.e., pre-staged equipment), (6) administrative hurdles from FEMA in efforts to make non-PRASA systems eligible for temporary repairs or emergency power, (7) all hazardous materials needed to be transported to the mainland, (8) contracting issues associated with the procurement of ambient air monitoring equipment for Puerto Rico, (9) use of DOI's IPaC system to conduct Endangered Species Act Section 7 consultations for HHW staging areas worked well, and (10) central drop off locations for community members to bring HHW was the most efficient collection system.

Ernesto Diaz, DNER/DRNA, started the presentation stating that communities were not prepared for a category 4 or 5 hurricane. For example, the power grid failed, communications went down and fuel (e.g., gasoline) was not being distributed post-disaster. In the midst of the disaster, DNER submitted a request for Mission Assignments under FEMA ESF 10 to work with the USCG, USACE, and NOAA. DNER submitted a resource request form (RRF) for sunken vessel removal in coordination with USCG, as well as an RRF for coastal, nearshore and beach debris removal with the USACE. The USCG came prepared to respond and had a clear path towards response which helped to guide DNER protocols. Through this process, DNER began developing and fine tuning their own protocol for sunken vessel removal and recommended that the protocol be further refined. Due to legal issues, marine debris removal halted progress and a lot of the work has not been completed. The process was divided into two phases: the first was manual removal of debris the second is debris removal using heavy equipment. Phase two has not been started. Additionally, DNER requested FEMA (i.e., NCR) to conduct damage assessments and support progress when developing COAs for coral reefs, seagrasses, beaches, dunes and wetlands. In order for coral reefs to be eligible as a critical maintained natural infrastructure' and receive funding, FEMA required documentation through a scientific review, regarding how reefs protect coastlines. In cooperation with CariCOOS, they were able to show that waves were attenuated by reefs and that damage costs were minimized and not incurred by FEMA because reefs were able to protect shorelines. Now, insurance has recognized that reefs are an important coastal protection and worth rebuilding and maintaining.

Due to short staffing and limited resources the DNER was divided, some employees conducted damage assessments, while others stayed at the JFO to work on reports. A major lesson learned was that some communities did not know what an RRF was, how to submit it and check that it was filed properly. If an RRF was not submitted, then FEMA was unable to address the issue. It is recommended that training be conducted at the municipality level to inform workers what an RRF is and how to properly file one.

In order to be prepared for future natural disasters and storm events, DNER recommends that detailed maps of built up areas and natural assets be compiled ahead of time. This will help to set a baseline and streamline the damage assessment process. Through this rebuilding process, it has been highlighted that infrastructure must be built back stronger than before, and retrofitting of homes needs to provide resiliency for future events. Additionally, corals and natural infrastructure must be maintained and restored to protect coastal communities, critical infrastructure and biodiversity.

Carlos Irigoyen Gonzalez, Puerto Rico Emergency Management Agency (PREMA), noted that the mission of PREMA is to coordinate all resources from the government and private sector, in order to provide the fastest and most effective services before, during and after emergency situations to ensure the protection of life and property of citizens. Hurricane Maria devastated Puerto Rican municipalities,

and many were designated eligible for the Public Assistance and Individual Assistance programs. 70,000 homes lost their roofs and there was a total collapse of essential services such as communications and warehouse space. The Emergency Operational Plans of the government agencies and municipalities were scaled up from lower category hurricane to address damages from a category 4 or 5 hurricane such as Hurricane Maria.

As a result, uniform systems of plans, training and exercises have been developed. The state/commonwealth and the municipal emergency management structure is strengthened, and changes have been made to the supply distribution plan, so as to avoid running out of warehouse space and commodities, and to ensure citizens receive important necessities quickly and in an orderly fashion. Working on the installation of satellite communication systems is a major priority; radios of 100 watts are being installed in hospitals, police stations, fire stations, EMS Central Communications Center, and OEM offices around the island. These radios have the ability to work without the need for repeaters. An alliance with the private sector has been initiated, which is the first time private companies have been included in the EOC. Sectors such as manufacturing, food, hospitals, telecommunications, broadcasters, media, infrastructure, transportation and fuel industries have all been part of this conversation. Many lessons were learned during the implementation of ESFs and now we must apply those lessons learned to change the way response is implemented.

Christa von Hillebrandt-Andrade, NOAA NWS Caribbean Tsunami Warning Program, discussed missions, products and protocols that can be expected in the event of a tsunami. Communication is crucial because time is of the essence. Once the earthquake occurs there is limited time for citizens to go to high ground (minutes to as most hours). There are both natural and official warning signs of a tsunami that people need to know. In the case of a local earthquake and tsunami, the first natural warning will be strong earthquake shaking; other natural cues are rapid sea level changes and roaring sounds. Self-evacuation is key for survival and requires individuals to identify and act on these natural warnings. Official information will be distributed through federal, state/commonwealth and local entities.

Tsunami warning centers (TWC) monitor seismic and sea level data 24-hours a day, 7-days a week. There are five types of messages that they issue:

- Warning (highest threat level, inundation expected)
- Advisory (second level, strong currents expected, but not coastal flooding)
- Watch (for distant tsunamis, when travel times are greater than three hours, threat level still under evaluation)
- Information Statement (no tsunami threat expected)
- Cancellation (dangerous waves/currents no longer expected - different from all clear which is issued by emergency management indicating safe to return)

The Pacific Tsunami Warning Center (PTWC) tracks the Caribbean and is responsible for issuing the official tsunami alerts for Puerto Rico and the U.S. and British Virgin Islands. If the TWC detects a strong earthquake, the data are analyzed and, if necessary, a message is pushed out to the public and authorities through various communication channels. Communication channels include NOAA Weather Radio, Emergency Alert System, NWS website https://tsunami.gov/. State EOCs, local weather forecast offices, the Puerto Rico Seismic Network (in the case of PR and the Virgin Islands) and USCG, which

distribute to specified audiences (e.g., USCG in charge of alerting mariners), all support the dissemination of tsunami alerts. In the case of a warning, certain wireless phones and other compatible mobile devices will receive a Wireless Emergency Alert (WEA) from the TWC. The text like geo targeted message will alert of the imminent tsunami threat in the area. The WEA will probably be the fastest way to receive a tsunami warning as it is generated directly from the PTWC. PRSEMA is also authorized to send WEAs.

Once the initial tsunami warning goes out, local authorities use this information to alert the community and initiate evacuation plans. The warning messages include information useful to emergency managers and responders, such as threat level and an estimate time of arrival and forecast wave height and duration of the tsunami. The most important take-away message from Ms. von Hillebrandt-Andrade was to keep messaging to the public consistent, use a central information source and be familiarized with tsunami messaging prior to an emergency response.

More detailed description of tsunami preparedness was discussed on the third day of the workshop and can be found in the *NRPT Training Section: Tsunami Scenario*.

Day 2 – April 24th, 2019

Ernesto Morales, NOAA NWS, discussed his agency's role in assisting decision makers for emergency management and preparation before an extreme weather event. The NOAA/NWS mission is to provide weather, water and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy. Within NWS there are two offices: the Weather Forecast Office (WFO) San Juan and the National Hurricane Center (NHC), which have the same mission, but a different scope. The NHC focuses on the forecast of the intensity and trajectory of tropical cyclones whereas, WFO San Juan concentrates on local forecasts and impacted areas based on the NHC forecast.

Communication between NWS and emergency managers is an intensive process which begins prior to and continues throughout the extreme weather event. Depending upon the timeframe prior to an extreme weather event, the types of graphics and information available to decision-maker changes. Very long-term forecasts (e.g., 7 day) are less accurate than a short-term forecast (e.g., 48 hour), and the graphics available to external partner changes. Once a cyclone begins forming, and confidence in the storm intensity is established, meteorologists conduct hazardous weather outlooks, emergency management briefings, media interviews, social media posts, graphicasts and NHC tropical weather outlooks.

As time gets closer to the predicted extreme event (i.e., day 2 to 12 hrs.), NWS puts out multiple products: a hurricane local statement, Tropical Cyclone Valid Time Event Code (VTEC), track forecast cone, hurricane watch, hurricane warning, and NHC wind speed probabilities. A new forecast cone is developed displacing the old forecast cones; updates include highlighted warnings and a smaller cone due to less model error. The newer forecast cones give more information regarding wind speed at the center of the cone and miles outside of the center that are likely to be impacted by tropical storm winds.

As the extreme weather event gets closer (i.e., 12 hr. to 3 hr.), hurricane local statements, Tropical Cyclone Watch/Warning (TCV) and other short term standalone products are available to decision makers. Just prior to the weather event, a notice of extreme wind, flash floods and other potential

hazards is released. A major lesson learned is the need for decision makers and emergency managers to build a relationship with local weather service folks prior to extreme events. This helps build trust and formulates a central, official source for weather information. Additionally, it is important for emergency responders to understand how to read forecasts and interpret important graphics.

A more detailed description regarding how to read and interpret weather and forecast documents is covered in the *NRPT Training Section: Hurricane & Coastal Flooding Scenario.*

Carlos Irigoyen Gonzalez, Negociado para el Manejo de Emergencias y Administracion de Desastres NMEAD, detailed the importance of risk communication, outlined challenges when responding to severe weather events and discussed ongoing projects. During severe weather, it is important to keep in contact with the NWS and maintain an official source of information. Once the official source is identified and messages are formed, information needs to be distributed to the community. Information generally flows from the Hurricane Center in Miami and NWS to the EOC headquarters, from there to regional EOCs and then to the municipalities. It is important to have redundant systems of communication (e.g., satellite phones, 100 watt radios, internet, media, TV, radio stations), such that messages are being properly relayed to municipalities and the public.

NMEAD is working with FEMA in a pilot program to install new all warning sirens systems, including the 87 sirens already existing for the Tsunami Program in Puerto Rico, of the 46 sirens in coastal municipalities, only 28 are working after Hurricane Maria; the other are still pending for insures companies to pay for the repairs. In coordination with FEMA, the new all hazard warning systems will cover all municipalities in Puerto Rico. All hazard warning systems include places such as Guajataca Dam, in case it fails a proper warning system would be in place. Additionally, installation of 100 watt radios in different municipalities has been underway, to increase back-up communication in the event of an emergency. There has been a lot of effort to educate communities on preparedness and planning, as well as keeping the public engaged about the potential threat of tsunamis and hurricanes.

Dr. Mirelsa Modestti González, Universidad del Sagrado Corazón, provided feedback and tips on how to successfully use social media in the event of a natural disaster or extreme weather event. It is important to recognize that people of all ages and demographics are using social media as a valued source of information. In order to build an audience and maintain followers before an event, organizations need to be an online presence by posting on a regular basis. Posts need to be created taking into consideration the public and characteristics of the different types of social media. Information needs to be presented in an easy to read manner, with critical information at the forefront and secondary information via links to other webpages. Use of graphics (e.g., videos, interactive maps, pictures) and simple, common language in the form of bullets are aesthetically pleasing and essential when reaching all demographics. Culture should be taken into consideration when developing posts and announcements, and celebrities and 'influencers' should be invited to trainings, as they can be extremely valuable because of their outreach. They should have access to official information websites and be asked to share official posts on their pages. Also, they should be encouraged to have links to official information websites on their fan pages.

Special care should be taken with certain types of messages. For example, when a Tsunami Warning cancellation is emitted, many people will interpret the cancellation as an "all clear" notification and will try to go back to their homes. It is of utmost important to state that it is NOT safe to go back to the coast before using the word "cancellation".

In the event of an emergency, downloading large files (e.g., videos, graphics) may not be possible given data limitations. Therefore, content should be concise and ingestible when data is limited. Prior to writing public messages, consider the audience trying to be reached (e.g., cultural preferences, language). When formulating them, use bolded fonts and colors to convey your information efficiently (e.g., bold, red letters indicates warning).

Misinformation or incomplete information is a problem. During emergencies, many people share incorrect or incomplete information. Therefore, a central page for disaster information that can be accessed by the public is highly recommended. In addition, each municipality could use their own specific platform as a central form of communication. It could be used to update the public about open or closed roads, available drinking water sources, etc. These platforms can be linked to the central disaster information page. Some platforms and social media require less bandwidth than others, and this caveat should be considered when choosing or retrofitting an existing central communication platform or service.

V.   Breakout Session I

The first breakout session took place following the plenary presentations on Day 1. The plenary discussion covered federal, state/commonwealth and local government challenges and lessons learned through hurricane response. The participants were divided into four groups (i.e., Groups A, B, C and D). Each group was tasked with identifying response challenges and subsequent lessons/skills/practices learned as highlighted from plenary presentations. For each identified response challenge and associated lessons learned, the participants compiled information on: type of event, timeframe of occurrence, safety of staff or staff families, cross jurisdictional issues, and shared trust resources. The summaries of the breakout group discussions capture major discussion points. See Appendix D for exact wording and all of the identified challenges and lessons learned.

Group A

Group A explored eight response challenges, and divided them into: communication, resources, preparation and leadership (Table 1). For example, one response challenge was that as a hurricane approaches, community members do not take forecasts seriously because there are too many unofficial sources of information. The lesson learned coming from that discussion was the need to socialize which media outlets are reliable, existing official sources of information and unofficial, misleading sources. This challenge occurs throughout mission response, and it threatens the safety of staff as well as their families and is a cross jurisdictional concern (e.g., federal, commonwealth, municipal). One solution is to conduct ongoing education in schools and at community meetings to inform the public where they can find credible sources of information and socialize official information sources such as NWS.

Table 1: Response challenges and lessons learned determined by Group A's breakout group discussions.

Identified Response Challenge	Lessons/Practices/Skills Learned
Desensitizing of alarms	Take culture into account when designing communication
Not taking forecast seriously	Information needs to put everyone on same page (official source)
Sources of information	Educate public to follow official source(s) of weather information
Lack of maintenance of resources	Prepared before event, need maintenance logs and funding necessary
Not enough resources	Cannot properly respond causing "snowball" effect, improvisation insufficient, must plan ahead, stockpile supplies beforehand, (access and distribution) *More efficient distribution system that is equitable, prior plans (&funding?) of impartial parties responsible for distribution of resources to communities (NGO, Red Cross, churches)
Communication infrastructure	Redundancy with options, total loss of communication can happen, ham radio can work
Lack of plans for an event of this magnitude	Need to plan, practice, train for worst case scenarios
Leadership	Empower (training, organizing, informing) communities is crucial, developing volunteering structure (cultural shift); in response to communities not relying on government, training of leadership,

Group B

Group B identified 16 response challenges; priority challenges are bolded (Table 2). Examples of response challenge categories included rapid assessments of damage/debris, consideration of policy changes to include green technologies when applying for funding, and the need for pre-scripted mission assignments. One response challenge identified by Group B was to avoid restructuring organizations during a response, (e.g., do not introduce new sectors or grant managers part way through a disaster response). The lesson learned were: that building a new type of structure during a disaster creates added pressure, lack of experience and unclear goals. While this is a concern throughout mission response and recovery activities, it specifically focused on federal jurisdiction and FEMA. There is an added concern for the safety of staff/staff families both mentally and for field safety.

Table 2: Response challenges and lessons learned determined by Group B's breakout group discussions.

Identified Response Challenge	Lessons/Practices/Skills Learned
Response plans exist	Lack of ownership, accountability, dissemination, actualization
Land Use Plan	Enforcement of sensible use of land use plan and zoning; assess on paper, but not in reality (i.e., zoning)
Communicate the severity danger/risk	Because of the size of the island, confidence in the forecast/warning; people get desensitized with many hurricanes missing Puerto Rico; so many warnings with nothing happening, people choose not to respond

Simultaneous hazard events may require unknown flexibility	Tabletop exercises that are more complex, multi-scenario, some scenarios require staff safety ahead of protocols, need redundancy
Capacity for multiple, simultaneous disasters	Climate change could lead to stressors to staff/resources/retention.
Marine/land debris hindered by lack of staging areas and logistics	Pre-identified staging areas needed
Rapid assessments of damage/debris are critical	Areas that had quick assessments made it easier to scope federal funding
No restructuring of organization during a disaster*	**Building a new type of structure during a disaster leads to added pressure, lack of experience, unclear goals**
Policy guidelines need to be revisited due to new technology and climate change*	**Policies need to be revised before an incident**
Police evacuation of people in danger zones when cell service down	Pre-emergency coordination with municipalities (door knocking, whatsapp) repeat weather messages
Deadlines need to be flexible, but…	FEMA extends deadlines. Is this good or bad? False expectations. Inefficient timeframe
Broad and bold on initial assessments	Baseline for FEMA to consider funding opportunities (e.g., repair, restoration)
Lack of Pre-Scripted Mission Assignments (PSMA)/Duplicity of efforts*	**The more pre-scripted mission assignments, the quicker response activities can commence and provides training opportunities within agencies**
Other Federal Agencies (OFAs) need to be assertive in their supplemental funding request*	**You snooze, you lose (i.e., there is often a very limited window for supplemental funding requests.** Identifying the needs and collecting the appropriate information must be conducted prior to the funding request, making a timely, speedy response more difficult.
Community response efforts. Develop a community plan.	Community members segregating debris; reaching out to the elderly; local communities will engage if given the opportunity, they take ownership, sense of community (helping your neighbors)

*Bolding indicates priority items

Group C

Group C captured nine response challenges within their discussion (Table 3); ranging from logistics e.g., getting resources to the island, and distribution of resources once received), to high turnover rates of emergency response positions at the local and commonwealth levels. One response challenge identified by this group was not pre-emptively involving the private sector when developing emergency response plans. A lesson learned was that the private sector be involved during contingency planning in coordination with PREMA. Connecting the private sector to municipalities could improve distribution of goods after a disaster, and allow private businesses to contribute to response efforts using their connections and assets at all levels (e.g., community, regional). This is a cross jurisdictional problem (i.e., federal, regional, local) and spans throughout planning, response and recovery.

Table 3: Response challenges and lessons learned determined by Group C's breakout group discussions.

Identified Response Challenge	Lessons/Practices/Skills Learned
Communications & interoperability between organizations/groups	Requires a compatible system
Communication	Back to basics- simple solutions (e.g., radio, information runners)
Interpersonal- layers of bureaucracy slowed progress	Need to identify an authority- previously only identified problem
High turnover rate of response positions	Need to maintain and document experiences, and put them into practice. Done through education and more trainings
Pre-emptively involve private sector	Involve private sector during contingency planning. Make the link on how to support municipalities/local organizations (e.g., transportation/ gas/food)
Release of emergency supplies in ports	Circumvent barriers using emergency declarations to streamline (e.g., turn off taxation during response)
Assets to people	Use multiple avenues to distribute resources (e.g., NGOs, faith based & private)
Getting community to know and buy into existing procedures/frameworks	Better communication of information & informing communities at the grass roots level
Logistics	Pre-planning on how to get resources to the island, and distribution in reasonable amount of time

Group D

Group D highlighted ten response challenges (Table D), ranging from access to clean water, identification of vulnerable populations before a disaster, port accessibility during response and lack of enforcement of residential building codes. An example of a response challenge was that vulnerable populations (e.g., disabled, sick, elderly) were stranded following Hurricane Maria. The associated lesson learned was not to wait until hospitals are actually impacted by a storm to make decisions, but to have a contingency plan for back-up energy sources and access to other necessary resources. This falls under the preparation timeframe including the safety of staff/staff families and is potentially a cross-jurisdictional concern (e.g., federal, commonwealth).

Table 4: Response challenges and lessons learned determined by Group D's breakout group discussions.

Identified Response Challenge	Lessons/Practices/Skills Learned
Ability to communicate with small communities	Post emergency communication needs to be simple and tailored to community
People inadequately prepared for Category 4 or 5 hurricane	Should prepare regardless of category level
Communities relying on social media and not official sources of information	More outreach about official sources of information

Lack of emergency planning	Local level preparedness plan created with central point of information
Contingency planning for emergency communication	Need for more than every-day, standard communication
Lack/enforcement of residential building codes	More damage and loss of life due to unsafe structures
Vulnerable population	Hospital will be impacted. Need redundant or back up energy sources
Access to clean water	Anticipation that water shortages occur
Port accessibility limited because of Jones Act	Necessary aid could not be distributed/get to local communities quickly
Current infrastructure was/is not hurricane ready	Maintain/update infrastructure to withstand hurricanes

VI. Breakout Session II

Breakout Session II took place on the second day of the workshop, following morning plenary presentations. Participants were asked to expand upon challenges and lessons learned established during Breakout Session I. The challenges and lessons learned were condensed and categorized into one of eight categories: communication, infrastructure, leadership, logistics, policy, preparedness, response, and logistics. Each group received the same template. The template had 23 response challenges and lessons learned; the groups were tasked with identifying improvements (i.e., actionable tasks) and how their approach would differ with respect to a tsunami or a hurricane. The number of items each group discussed varied, but all 23 items were covered. The summaries below do not detail every topic discussed by the groups, but focus on critical points. See Appendix D for exact language and completed templates from each group. The condensed and categorized response challenges included:

1. Communication
    a. Communication with small communities
    b. Communities relying on social media and not official sources of information
    c. Contingency planning for emergency communication
    d. Communication of the severity of danger/potential risks
2. Infrastructure
    a. Lack of and enforcement of residential building codes
    b. Lack of access to clean water
    c. Current infrastructure was/is not hurricane ready
    d. Poorly maintained infrastructure
3. Leadership
    a. High turnover within leadership positions and trained personnel; limited capacity for multiple, simultaneous disasters.
4. Logistics
    a. Port accessibility is limited during response because of existing laws (e.g., Jones Act)
    b. Marine/land debris clean-up hindered by lack of staging areas and removal logistics

5. Policy
   a. Land use policy (e.g., rebuilding in high-hazard zone)
   b. Policy guidelines need to be revisited due to change in technology, climate, etc.
   c. Other federal agencies (OFA) need to be assertive in their supplemental funding request
   d. Interpersonal layers of bureaucracy slowed progress (i.e., politics getting in the way of progress)
6. Preparedness
   a. People inadequately prepared for Categories 4 or 5 hurricanes
   b. Lack of emergency planning at family, local and regional levels
   c. Simultaneous hazard events may require unknown flexibility
   d. Lack of Pre-Scripted Mission Assignments (PSMA) led to duplicity in efforts
   e. Private sector not pre-emptively involved
7. Response
   a. Rapid assessments of damage/debris were critical; FEMA needs a baseline to consider funding opportunities
8. Inequity
   a. Vulnerable populations left stranded during/after disasters

Group A

Group A discussed 10 of the response challenges, the categories they focused on included: communication, infrastructure, leadership, logistics, policy, and preparedness. Within the communication category (1b), the group focused on actionable tasks such as certifying official information sources so that community members can trust those sites. This would require community outreach, socialization of official sources of information, and learning how to read forecast maps. Within the infrastructure category (2b), this group focused on improving access to clean drinking water. The actionable tasks included: promoting/educating communities on how to install and fix rainwater collection systems, requiring new residential construction to include cisterns or rain collection systems, and community workshops to teach members about potential risks associated with drinking untreated water. Under the logistics category, port accessibility in the event of a disaster (4a), and the need for establishing a protocol which automatically waives laws such as the Jones Act for a reasonable time frame were key. Another topic of discussion was policy changes with respect to land use (5a), and rebuilding in high-hazard areas following a disaster. The action items include enforcement of existing codes, consistency in codes, and implementation of new codes to consider zoned and future land planning. The final category covered was preparedness, lack of emergency planning (6b); this group recommended educating/outreach to remind people of the possible devastation following a disaster. Keeping the memories fresh in their mind, but also providing avenues to educate communities on how to plan and prepare their families. This could be done in coordination with existing organizations (e.g., faith based groups, schools, NGOs), as well as practicing evacuations through exercises.

Group B

Group B covered five response challenges within the categories of: communication, policy, preparedness and response. Action items under the communication (1a), included the ability to communicate with small communities, and recommendations that responders be aware of language and cultural needs when working with various communities. Following a disaster, there should be multiple, central locations where information can be posted regarding weather forecasts and other critical information.

Pre-training at the community level would help families understand the necessary resources to survive many days following a disaster (e.g., food, water, radio). Additionally, under the policy category (5b) policy guidelines (e.g., PAPPG) should be revisited to include new technology and climate change. Potential improvements would require high-level policy agreements on existing FEMA public assistance, mitigation and recovery policies. Within the preparedness category (6a), this group recommended that social scientists be active and engaged in community outreach to educate the public and local leaders regarding family planning for disasters. Exercises should be completed at the community level to test storm-readiness, and develop a checklist of necessary items families should have in the case of a disaster. Another facet of preparedness includes PSMA (6d) to avoid duplicity of efforts. This could be done by reviewing existing mission assignments, developing new ones and integrating federal mission assignments with local response organizations. Fast-tracking mission assignments could be completed with automating approval documents by obtaining signatures ahead of time, and responders could prepare for assignments through training and exercises. During the response and recovery activities, communities that conducted quick assessments of damage made it easier to scope federal funding. Building from this lesson learned would require a centralized application to collect assessment information from multiple sectors. This would ultimately allow the public to report on their municipalities.

Group C

Group C covered response challenges under the categories of: communication, preparedness, response, and inequity. With respect to communication challenges, this group provided actionable tasks to improve communication with small communities (1a) and contingency planning for emergency communication (1c). These improvements entail using short wave radios for response, satellite phones and back-up power sources such as generators, installation of PA systems, low-wattage phones, satellite computers and solar powered hard-drives accessible by community members to communicate with exterior networks. Additionally, it is important to educate the community at large on how to use these technologies and practice using equipment during planned exercises. Providing training for communities is important to instill emergency readiness at the individual level, because individual preparedness leads to a stronger central response. In addition to communication improvements, there was a lack of emergency planning and preparedness (6b) at the local and family level with respect to necessary supplies. This group recommended that aggressive pre-planning would help allow individuals to be self-sufficient for a longer period; this would include having appropriate quantities of food and water, redundant energy sources, and first-aid/logistical resources (e.g., maps, flash lights). These tools and readiness checklists could be socialized through existing outreach programs (e.g., CERT) and practiced in schools and at community centers. During the response phase (7a), rapid assessment of damages resulted in a higher likelihood for funding through FEMA. Therefore, establishing a pre-storm baseline would streamline the assessment process and clarify what damage was caused by the recent disaster. Documentation of the current state of infrastructure establishes who is responsible for rebuilding after the disaster. This group discussed the challenge of vulnerable populations being stuck in place/stranded following a disaster (8a) and the need for pre-identification of vulnerable populations to determine who is at risk, where they are located and how people/community members are accounted for during and after a disaster.

Group D

Group D covered five of the eight categories: communication, infrastructure, logistics, preparedness, and inequity. A major topic of discussion was identification of vulnerable populations (8a), through preplanning and existing contingency plans. Assessment of vulnerable populations allows emergency responders to preemptively determine the communities' strengths and weaknesses, who is capable of evacuation, and how responders get to those people faster. The action items included: (1) using census and demographic data to identify vulnerable populations during emergency preparedness planning in order to focus response efforts during an emergency event; (2) creating compliance checks within low-income communities to identify any obvious hazards in homes; (3) providing recommendations for improvements rather than punitive penalties. Within the infrastructure category, (2a) enforcement of building codes would ensure a safe structure in the event of a disaster; if not possible for all residences, there should be a safe structure where the community members can go. Additionally, community outreach efforts should provide training on how to harvest rainwater, install tanks appropriately, the importance of treating water prior to drinking it, and solutions such as sand filters or camp filters to increase individual self-sufficiency following a disaster.

VII.   Breakout Session III

The final breakout session took place on the afternoon of Day 2.   Building upon Breakout Session II, each group was asked to: (1) recommend steps for implementation, (2) rate the ease of implementation, and (3) document any potential coordinating partners. The summaries below focus on high level ease of implementation outlined by each group and/or topics unique to that group discussion. For completed templates and exact language, see Appendix D.

Group A

Group A highlighted two lessons learned that have the potential to be easily implemented. They focused on improving the maintenance of infrastructure and avoiding rebuilding critical infrastructure in high-hazard areas. In order to improve the maintenance of infrastructure, this group recommended that courses and certification programs be developed to authenticate contractors. This would mandate specific training, and teach contractors best management practices when preparing for hurricanes. Additionally, Category 4 and 5 rated buildings should be built in centralized locations to provide shelter and protection for evacuated families. This would require coordination between governments and engineering organizations, insurance industries and the community. The second area of improvement falls under land-use planning. This would require identification of risk-prone areas, and development of new land use regulations to prohibit new construction within high-hazard areas. If buildings need to be reconstructed in those areas, then they should follow special codes and best practices to ensure buildings are structurally sound. Coordinating partners include local and state governments, permitting agencies, municipalities and community members.

Group B

This group did not have any lessons learned with a high ease of implementation, but rather prioritized a challenging lesson learned. The lesson learned is that OFAs need to be more assertive in their supplemental funding requests. Some items FEMA cannot fund, but delays in OFA submission requests mean they are less likely to be funded. Action items to accomplish this would be identifying and establishing consistent language across agencies; each agency should be responsible for educating their

employees. Agencies should be aware of supplemental funding opportunities (i.e., grants, special project funding) and responsible for requests relative to their particular mandates. Socialization of coverage/vocabulary could be completed through workshops on how to find funding opportunities, how to write grants, petitions, and procurements and how to submit federal grants. Annual meetings needed between local emergency coordinators along with state officials to start knowledge sharing from the federal level to the municipal level. Recommendations for implementation include: (1) interagency training on procedures of funding opportunities, (2) a survey for commonwealth agencies to take in order to gather post-event lessons learned on the supplemental grant process, (3) awareness raising for federal agencies on supplemental funding opportunities (e.g., grant, special project funding) for requests relative to their mandates, and (4) federal agencies preparedness with requests to Congress of supplemental funding according to their mandates.

Group C

Group C focused heavily on local level preparedness, creating contingency and emergency plans that direct community members to a central or multiple information source(s) around a community. Pre-emergency planning would include local law enforcement, impartial parties (e.g., faith based organizations, NGOs) and local emergency managers. Recommendations for implementation include education as a priority. This would require planning and executing workshops to build knowledge for local leaders, parents and/or children to teach families about preparedness planning. The workshops could be broken into regions to allow more people to attend from multiple communities. They would encourage community members to take ownership in emergency planning and promote self-sufficiency. This could potentially be done in coordination with NOAA's Office of Coastal Management and Sea Grant. The second recommendation is focused on outreach efforts (e.g., media blitz). This would include ads at movies, TV commercials, radio announcements, advertisements at stores, etc. to raise awareness about how to prepare and develop individual emergency plans and where to find official sources of information. Outreach/education could also take place at public or private classes (e.g., home improvement stores), youth organizations (e.g., boy scouts, girl scouts), or faith based organizations. The goal of this is to create self-sufficient communities through empowerment of individuals. Start with a pilot project, in one or two communities, to show that training exercises and education can improve preparedness, and would share results at a regional scale to encourage buy-in. This would require coordination between communities, NGOs, universities, media outlets, photo journalists and emergency management entities.

Group D

Group D highlighted two lessons learned that had a high ease of implementation. The first centered on removal of marine/land debris and the other on lack of emergency planning at the family and local level. In order to improve removal of debris, Florida's emergency management plans should be referenced as a best management practice document. Current contingency plans would then be updated to include pre-identified staging areas for marine debris, construction/demolition debris, and a final location for debris (e.g., landfill on the island vs. shipping off the island). This would require coordination between FEMA, USCG, local emergency managers, NOAA Marine Debris and local public works divisions. The second lesson learned is improving local level preparedness through: (1) re-instituting the CERT program in schools, churches, communities, etc., (2) its use in coordination with neighborhood watch programs, and (3) use of existing web-apps/phone apps to share information (e.g., "next-door" app).   VITEMA models are good and could and potentially be replicated as best management practices. Consistent

messages/information should be socialized at community events. The final recommendation is improving consistency of delivery of information, and institutionalizing self-reliance. Coordination partners include local agencies, emergency management agencies, FEMA, school systems/universities, and community members.

VIII.   NRPT Training

The design of the NRPT format includes a day of training. For this workshop held in Puerto Rico, the decision was made to conduct two table top exercises: (1) a tsunami scenario and (2) a coastal flooding/hurricane scenario. The exercises not only allowed for discussion as to good practices and not so effective practices, but how to properly interpret and communicate the meaning of watches, warnings, and specific NOAA products for decision making. The participants were divided into four groups to discuss and develop messaging products for different phases of these events. The exercises focused on effective communication, specifically:

What to say and how to say it effectively: fundamentals of risk communication and the use of social and traditional media to enhance communications and messaging before, during and after a major coastal event.

Tsunami Scenario

Prior to the exercise, Christa von Hillebrandt-Andrade and Carolina Hincapié from the NOAA NWS Caribbean Tsunami Warning Program, gave an overview about the U.S. Tsunami Warning System. Real-time seismic and sea level data are collected and sent through satellites to Tsunami Warning Centers (TWCs); the Pacific TWC (PTWC) covers the Caribbean region. If data shows anything out of the ordinary, it is reviewed and if necessary, a warning is sent from the PTWC through satellites to the NWS Gateway, State Emergency Operations Centers (EOCs), and the USCG (Figure 1). From there, each of those groups is responsible for distributing the warning message. The NWS Gateway sends out a wireless emergency alert (WEA) to those in coastal zones and in locations under threat. Additionally, the NWS Gateway distributes the message to the NWS San Juan Forecast Office (SJFO) activating (1) NOAA Weather Radio, and (2) Emergency Alert System (EAS) (e.g., TV, radio, fax). The State EOCs send warning messages to the local EOCs, and from there the local EOCs alert TV stations and local alarms/sirens. The USCG is responsible for notifying mariners, harbor and port masters, and releases a PanPan message (i.e., critical message for mariners). There are multiple routes of communication, some methods include: voice, text (satellite based), internet, phone and mobile technology (Figure 2). Each tsunami ready center has an office, and receives warning messages through multiple mechanisms (e.g., fax, NOAA weather radio, internet).
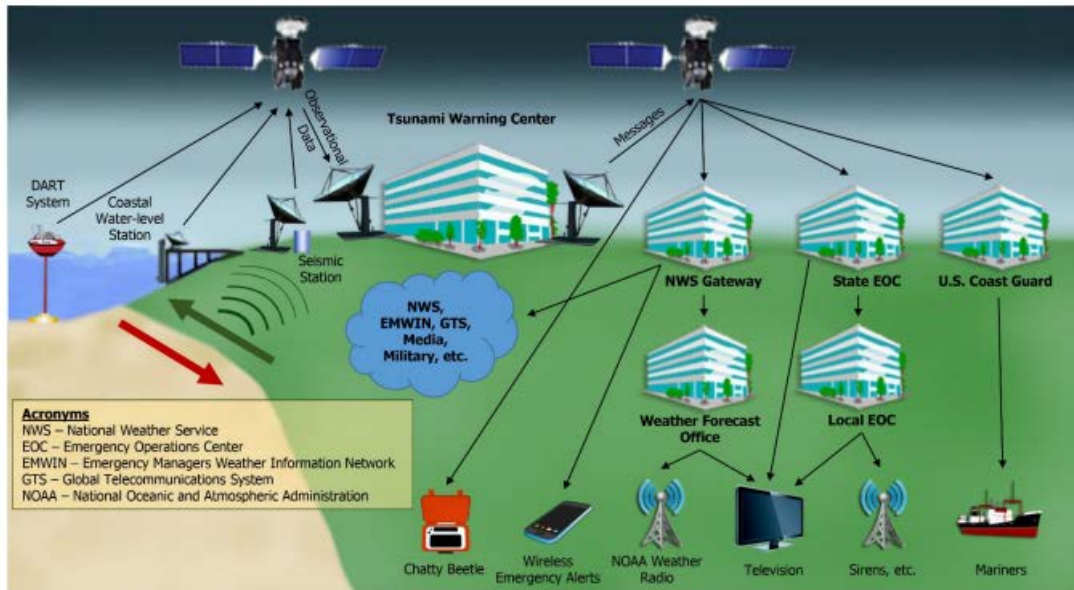
Figure 1: Communication diagram used by the United States Tsunami Warning System
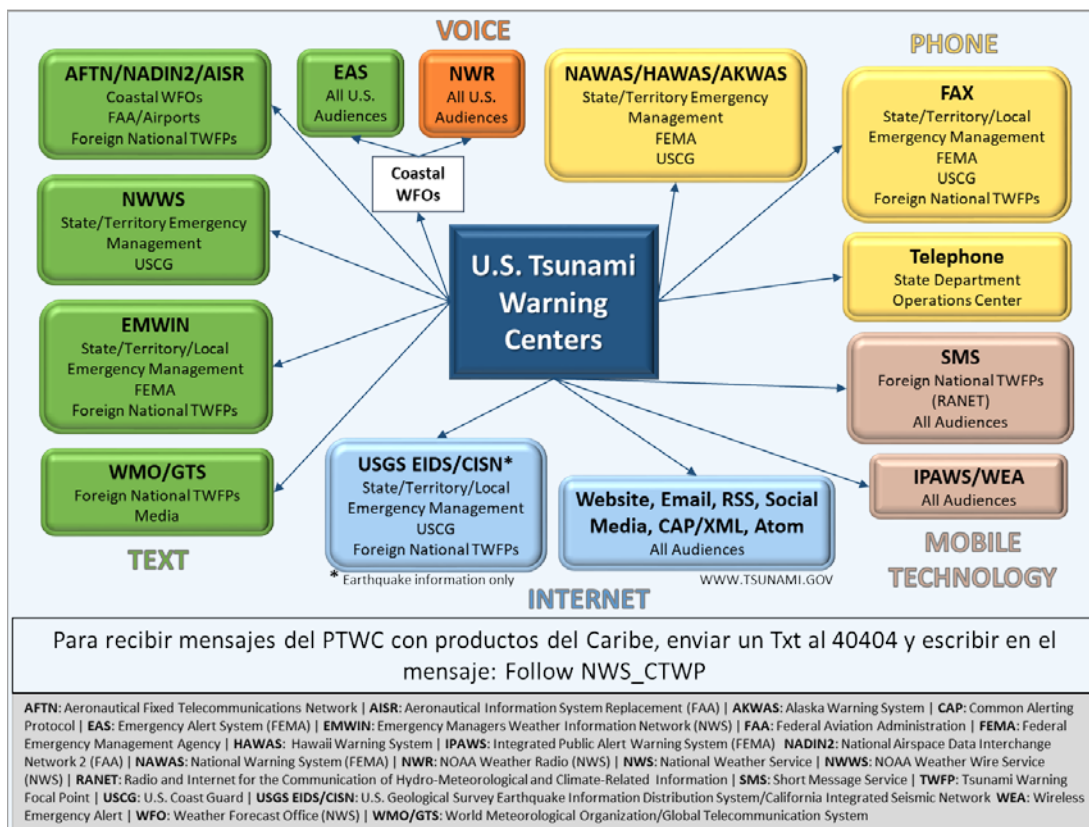
Figure 2: Routes of communication used by the United States Tsunami Warning Centers in the case of an emergency.

The official roles for the tsunami warning process start with the TWC, which is responsible for determining alert level and issuing the message (e.g., PTWC). The tsunami warning focuses, those

responsible for disseminating official alerts to authorities and the public including: (1) Puerto Rico State Emergency Bureau; (2) WEA; (3) VHF radio; (4) U.S. Virgin Islands Emergency Management Agency (VITEMA); (5) NWS SJFO to activate the NOAA weather radio, EAS and social media; and, (6) PRSN as an alternated tsunami warning focal point for PR and USVI, RSS, website, social media, VHF radio and ham radio.

The overview included a step-by-step discussion of the messages sent by the PTWC. Messages are issued in both English and Spanish and can be found at tsunami.gov, and in the case of a tsunami threat, include critical information such as: (1) message number, (2) who is sending the message, (3) time and date of message, (4) alert level, (5) parameters including location, magnitude and depth,, (6) earliest estimated time for tsunami arrival in coastal regions, (7) recommended actions to protect human life (e.g., evacuation, move to 4th story) (8) specific information about what NOT to do, (9) forecasts of tsunami activity, (10) anticipation of flooding/inundation, and (11) information about the next update. As time passes, more messages are sent to update information. For example, Message 2 includes information such as: updated estimated time of arrivals, height and duration of tsunami, and revision of earthquake magnitude, if necessary. Message 3 contains updates and confirmation of wave heights. The final cancellation message directs the public listen to local, public authorities for the official "all clear".

The short version of the message which is sent through WEAs to individual cell phones, currently reads:

Tsunami danger on the coast. Go to high ground or move inland. Listen to local news. -NWS

As part of WEA modernization, after much discussion the NWS has recommended a new message and send alerts in both Spanish and English depending upon the individual's preference.   After review of messaging, it was determined that the order of message content is important. In addition to the shorter message (90 character), a longer message (360 character) has also been agreed upon and is awaiting FEMA for implementation. For shorter messages, the order of content is as follows: source, guidance, hazard, location, time. The newly proposed English message reads:

NWS: Tsunami danger on the coast. Move to high ground or inland now.

The order of content for the larger messages is slightly different. It includes: source, hazard, location, time and guidance. Participants quickly learned that there is very little time for action once the warning is provided; it was stressed that they need to know what to do and act quickly. The proposed longer message, in English reads:

The National Weather Service has issued a tsunami warning. A series of powerful waves and strong currents may impact coasts near you. You are in danger. Get away from coastal waters. Move to high ground or inland now. Keep away for the coast until local officials say it is safe to return. Check local media for more information after you are safe.

The Tsunami Scenario learning objectives were:

1. Familiarization with TWC products and timelines
2. Improvement of communication of the threat message in PR/USVI by official Tsunami Warning Focal Point (TWFP) and social influencers.
3. Focus on four stages of warning:
    - Response to earthquake shaking

- Tsunami warning
- Tsunami confirmation
- Warning cancellation
- All clear

The participants were divided into four groups, groups included members with critical messaging roles, other members who acted as social influencers during the warning, and those who would normally be located outside of the Caribbean region. There were five activities. The first activity was done individually, but all others were conducted as a group. The five activities mimicked time as it would occur during a real event; members were to document their individual response as well as group discussion and messaging.

The activities included:

- Activity 1: Communications based on natural signs
- Activity 2: Communications with Message #1
- Activity 3: Communications with Message #3
- Activity 4: Communications with Message #8
- Activity 5: Communications for Response and All Clear

Tsunami Scenario Overview:

A magnitude 7.9 earthquake NE of Puerto Rico occurred at 11:00 PM. The earthquake occurred in the Puerto Rico Trench, where the North American Plate subducts under the Caribbean Plate.

This training included discussing the impact of a local tsunami to at-risk communities along the coast, examined the types of TWC messages in the scenario, and considered type, timing, audience and mechanisms for communications.

Activity 1: The earthquake is strong and is felt at 11:00 PM. Some buildings collapse; phone lines are immediately jammed as everyone tries to find out what happened. No TWC messages have been issued yet. The earthquake shaking occurred for 1 minute, during which time folk would likely be protecting themselves. The first scenario asked participants what they would do in the first three minutes (including the 1 minute of shaking). The following questions were answered by each individual: (1) How do you respond to the earthquake? (2) What do you think is going to happen (list the risks). (3) What can you do to communicate, to whom and how are you going to do it?

One member from Group B, who works at the Seismic Network of Puerto Rico (PRSN) pretended as though he was working on shift and saw information about the earthquake. Once the shaking began, he protected himself, waited until it was over and then watched his monitor to see if there was going to be another earthquake. Upon determining there was not another earthquake threat, he proceeded to try and send a rapid earthquake alert and establish that his partner was safe. If the partner was safe, then that person would try and establish communication with the PTWC. If no communication was available, there might be an issue with communication lines. If no information was received from PTWC then it is anticipated that all routes of communication are down; if no message from the PTWC comes within 5 minutes, then they radio to PREMA the magnitude and depth of the quake. If it is 100 km or shallower, PREMA must be provided with tsunami warning or watch information.

The participant representing PREMA assumed from the intensity and length of the earthquake that a tsunami was a high possibility. Therefore, he contacted local offices/regions to start evacuations immediately. Most other participants were either social influencers or out of the Caribbean region at the time of the event. Social influencers were focused on protecting themselves and establishing if their families were safe; some people were shocked by what happened and froze for a minute or two. Some said they attempted to contact community members, but did not want to clog-up lines of communication.

Activity 2: The time is now 11:03 PM, PTWC has issued its first message. Telephones are jammed, social media is viral, and the earthquake impact has been significant. Groups were then given 5 minutes to determine individual action, and 15 minutes for group discussion. Participants were asked to answer: (1) What and how did you receive the official product? (2) What is the alert level? (3) What is the expected time of arrival of the tsunami? (4) What, to whom, how and when are you going to communicate?

In terms of receiving official products, the answer would be through aWEBs (tsunami.gov) and WEAs. The next step is relaying NWS messaging. This would be via NOAA weather radio, fax, and phone calls; if normal lines of communication are down then satellite phones or radio would be necessary. The alert level is a warning and would be included in the message. The entire island must be included when issuing directions; messaging would be the same for all regions. Areas highlighted in yellow on the provided tsunami evacuation areas were designated as priority evacuation regions. Information would be shared with local EOCs and sirens sounded to alert areas under threat. Messaging should focus on the need for community members to get to higher ground (e.g., parking garage is a great option) or to the 4th story of a building and to remain there until local emergency response gives the "all clear".

Social influencers said they would re-tweet information put out by official sources (e.g., NWS, SJFO), contact neighborhood watch programs to see if community members are safe, and continue moving themselves and families to higher ground if they were in a threatened area. Some discussion focused on confusion about official sources' language in messaging; making sure it is clear to the public, avoiding use of acronyms and providing specific directions (e.g., imminent danger- get to higher ground).

Activity 3: It is now 11:55 PM, and the PTWC Message #3 has been issued. Media is reporting the tsunami is inundating the U.S. Virgin Islands and Puerto Rico; additionally, reports are showing that people are flocking to beaches to watch the arrival of the tsunami. This is causing coastal evacuation problems. The groups were tasked with identifying their actions over the next five minutes, followed by a 15-minute group discussion answering the questions: (1) What important new information does the message include, and (2) What, to whom, how and when are you going to communicate?

USCG participants mentioned that the communication center is in a tsunami risk area, and therefore, the center may not be functional if they are in the middle of evacuating. There are alternative operations centers, but the ultimate conclusion was that there would be limited capabilities in them. A take-away from this discussion was that in the case of a tsunami, it is unclear how USCG would issue warnings to mariners if the operations center is evacuating.

PREMA has sent their evacuation messages and continues to send out alerts with the time of wave arrival as it was described in the third message from the PTWC. After hearing media reports of people swarming beaches, PREMA contacted local media to encourage people to evacuate and keep away from

coastal zones. If people continue to swarm beaches, then the National Guard will be activated to move people inland. At the same time, PREMA is dealing with problems that arose as a result of the earthquake, such as power outages, road blocks and hospital damages.

A VITEMA spokesperson said that because it is a small island, information gets distributed quickly and emergency response is mobilized at a fast pace. When relaying important information to the public, specific estimated time of wave arrival should be avoided because if it does not hit at that time then people assume the threat is over and they are safe. Communicate after that the public must continue to evacuate threated areas and remain evacuated until further notice from local authorities. Due to limited resources, VITEMA focused their efforts in locations where the wave is expected to arrive first, especially on evacuating vulnerable populations (e.g., hospitals, schools).

The PRSN receives an alert within five minutes after the earthquake, indicating that lines of communication are open ultimately allowing for information updates (e.g., magnitude of quake, estimated time of wave arrival). Messages from the Seismic Network continue to encourage evacuation. Even after the first wave makes landfall, there is still a high risk of larger waves following. The next step would be to update/change which municipalities are flooded, the tsunami height, arrival time and duration. Continuous monitoring of tide gauges and UNESCO IOC water monitoring stations to see water level changes in real time is on-going.

Social influencers would try to share official sources of information, and warn people not to go into the streets after the first wave because more could be coming.

Activity 4: It is now 0225 AM, and the PTWC Message #8 is released; media reports the tsunami has inundated Puerto Rico coasts, and people are wanting to enter the evacuated areas. The groups have five minutes for action and five minutes of group discussion about: (1) what important new information should the message include, and (2) what, to whom, how and when to communicate?

There is a lot of controversy regarding Message #8 from the PTWC. The word "cancellation", for most people, means that evacuation zones are safe, and people can return. However, in this case, it means there is no more threat of a tsunami, and that the public should seek information from their local authorities about returning to evacuation zones. The threat of a tsunami is over, but the resulting damages from waves/flooding is mostly unknown and could pose life-threatening scenarios in coastal zones. PRSN recommends communities wait for further information from PREMA regarding when it is safe to return to their evacuated/affected areas. Concerns of how the media would interpret this message was discussed, and the PRSN representative said that they do outreach with local media to educate them about language used in warning messages. The warning messages are a public document, therefore, upfront education helps to eliminate the spread of misinformation. An action item that came out of this discussion was, rather than using the word 'cancellation'; the term 'end of tsunami threat' should replace it because that phrase is clear and concise.

A second action item was that other media outlets such as news broadcasters, and radio announcers should be trained about how to interpret PRSN messages and how the media should relay information. The media should keep messages simple, and avoid talking about the earthquake magnitude until after the event is over. Additionally, more outreach in schools would hopefully help educate people about terminology surrounding physical sciences to help prevent false information.

Activity 5: It is now 7 AM and the Puerto Rican Governor's press conference is taking place. Topics covered in the press conference include: (1) an initial report of the event and its effects, (2) an announcement that emergency management officials are in the field performing evaluations and will be the ones to issue the "all clear" when evacuated areas are safe, and (3) the fact that a curfew for citizens not participating in emergency response will be enforced. At this point, all participants have assumed their agency roles, and have 10-minutes to discuss: (1) what is the government guidance? (2) What are additional information sources? (3) What, to whom, how and when are you going to communicate? (4) What will be the roles in response?

At this point, participants said they would re-tweet official sources of information if there was access to the internet. WhatsApp is a great avenue for communication because it generally requires less data/bandwidth than social media outlets. When communicating to the public, social influencers would post messages such as: i) stay clear of activities, ii) it is important to let authority do their job, iii) be cautious of earthquake associated risks (e.g., collapse of structures), iv) go to the closest shelter, or v) do not return to evacuated areas until the official agency says it is safe to do so. An important take-away is the need for pre-emptive action to educate the public about emergency preparedness, and encourage self-sufficiency (i.e., what are you going to do to improve your situation?).

From the perspective of NOAA DPP in Mobile, AL; part of the role for DPP is supporting response coordination and information flow up through senior leadership. The first action would be to account for all NOS personnel in affected areas. Coordination of incident management and response such as mobilizing the National Geodetic Survey for an aerial survey and getting teams to support the USCG and EPA associated with hazmat and opening ports/navigational channels. The Office of Coastal Zone Management would be used to assist in anyway necessary; most importantly to get confirmation that folks in affected areas are safe (i.e., encourage a communications list or phone tree).

Hurricane & Coastal Flooding Scenario

The second scenario was led by Ernesto Rodriguez and Odalys Martinez, WFOSJ, regarding communications for a hurricane and coastal flooding scenario. There was an initial presentation reminding participants how to read forecasts, which forecasts to use as the hurricane approaches and how the WFO knowledge changes as a storm approaches (Figure 3). Providing responders with as much information as possible is important when preparing for a hurricane. When the hurricane is many days out (e.g., 7 days), guidance is general and there is minimal knowledge of the potentially impacted area, but as the hurricane approaches land, forecasts become more precise and information is provided for pre-staging operations.
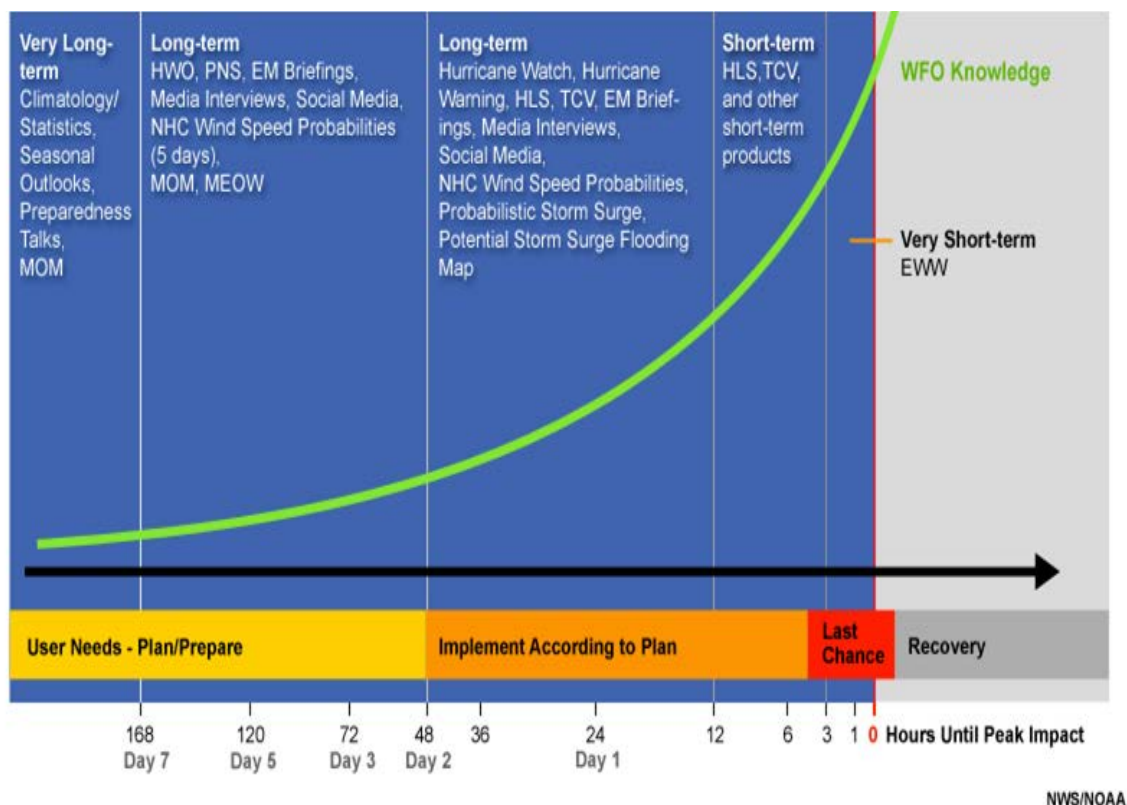
Figure 3: The timeline showing how WFO knowledge changes as a storm approaches, and forecast graphics that should be used with respect to hours until peak impact.

Five-day outlooks can be used to monitor a potential cyclone. Figure 4 shows an orange track, which is the area of tropical storm formation potential; the chance of formation is illustrated by the color (i.e., yellow=low risk, orange=moderate, red=high). The hatched (orange shaded) area does not represent trajectory, it is the area where conditions are favorable for development. The graphic has an associated text-box which outlines the potential formation chances through a 48-hour and 5-day timeframe. It discusses which direction the storm is approaching from, the direction it is moving, and how quickly it is moving. As the storm gets closer to landfall, forecasters can more accurately predict the formation chance, time to landfall and the subsequent impacts (e.g., heavy rainfall).
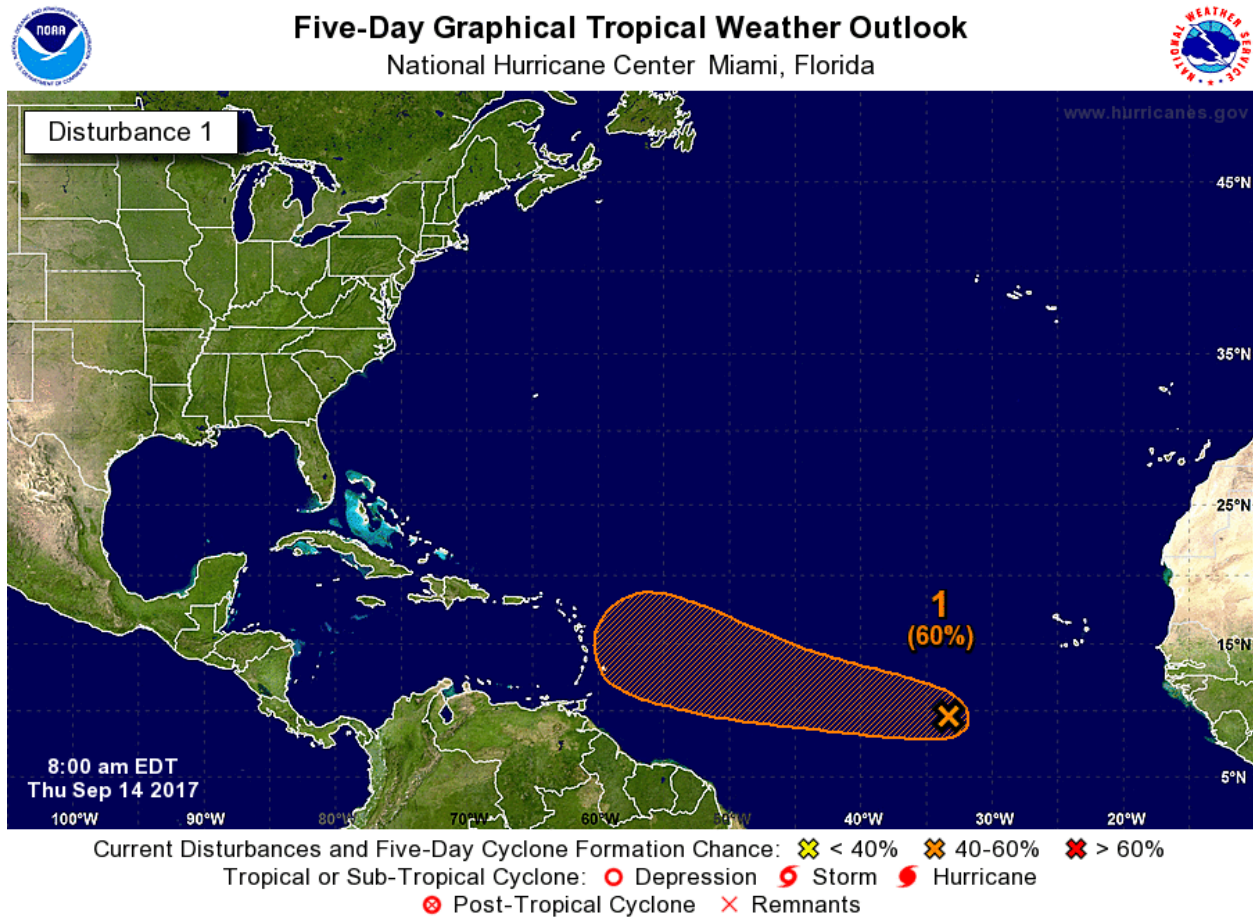
Figure 4: An example of a five-day graphical tropical weather outlook showing one disturbance (orange).

In general, the media does not cover hurricanes until there is a cone of uncertainty. NWS forecasters are monitoring its movement, development and track, but the model accuracy is not good enough to capture the attention of media outlets. The goal is to get information out to emergency managers as early as possible in order for them to start planning evacuation routes, staging equipment, etc. Due to associated costs with emergency planning (e.g., shipping equipment), the NWS does not tell partners about a potential storm event until they are confident in their predictions. The warnings of a storm can begin as early as 7-days; these will consist of email briefings, but will not give the exact location or impacts.

Module 1: Pre-Storm

1. *What should be considered when interpreting the Potential Tropical Cyclone Forecasts?*

Potential Tropical Cyclone Forecasts are issued only for systems threatening land within the watch or warning time period. Forecasts are likely to have greater uncertainty the further out they are. The NHC issues early advisories for weather systems that pose a long-range threat to the U.S. or other land areas.

An internal Model Guidance forecast track was shown to participants to illustrate the complexity of forecast models. Different models have different tracks; they are called "members". All models have a purpose and limitations, some of the model types are: climatological, historic, and deterministic or

ensemble.   Comparing the outputs of multiple models provides forecasters and decision makers with more data to make an informed decision. Forecasts are generally accurate 48-72 hours prior to an event, further out than 72 hours the uncertainty increases exponentially and model outputs vary dramatically (Figure 5). Typical NHC track errors are: i) 2-day error ~ 75 nautical miles (n mi), ii) 3-day error ~ 110 n mi, iii) 4-day error ~160 n mi, and iv) 5-day error ~ 220 n mi.
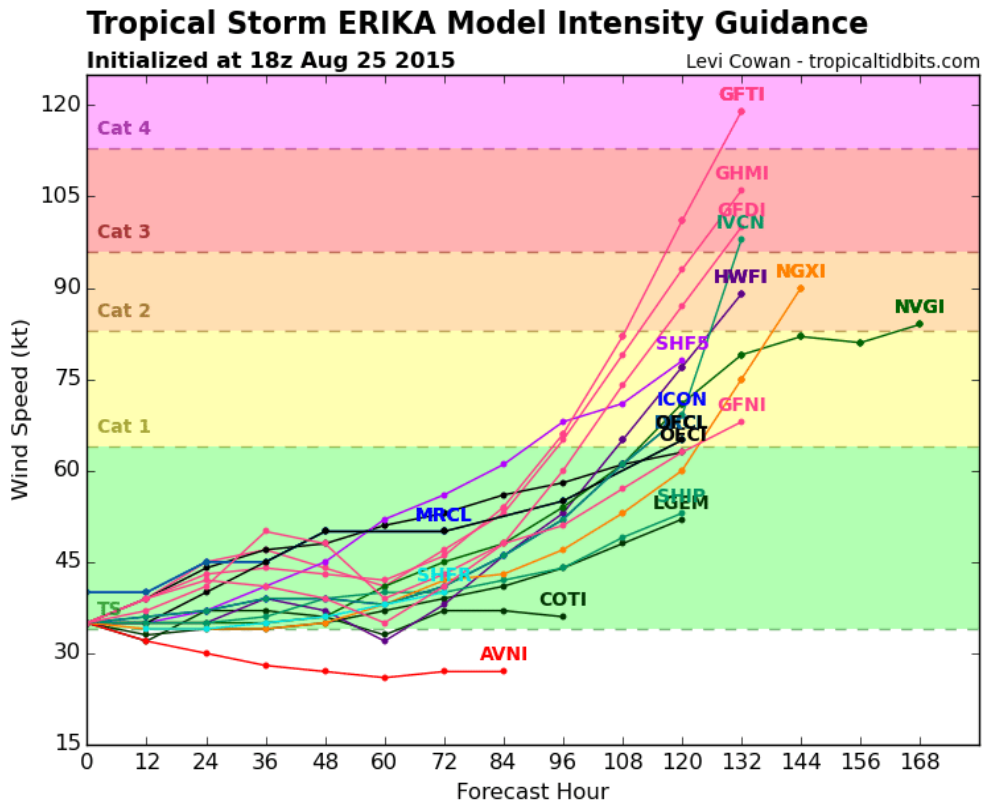
Figure 5: An example of internal Model Guidance of intensity forecasts, illustrating that model uncertainties increases with respect to forecast hour.

Models with cones of uncertainty explain two things, the timing of the cyclone and the related uncertainty. Error is not storm dependent. It is based on the 5-year historic averages and is included in every forecast track. Figure 6 is an example of a forecast with a cone of uncertainty. The hatched area is the 4 to 5-day outlook, and the solid white area is a 1 to 3-day outlook. The letters in the middle of the track represent different wind speeds. The cone itself contains the probable path of the storm center, but does not show its size. Hazardous conditions can occur outside of the cone. Additionally, the orange circle with the black dot, shows the current known information such as sustained winds and direction of movement. The goal is to send out an updated forecast every 6 hours; as computers get faster the ability to run models more often increases. It is generally hard to identify the center of a hurricane as it is developing, but as it intensifies the center is more obvious to forecasters.
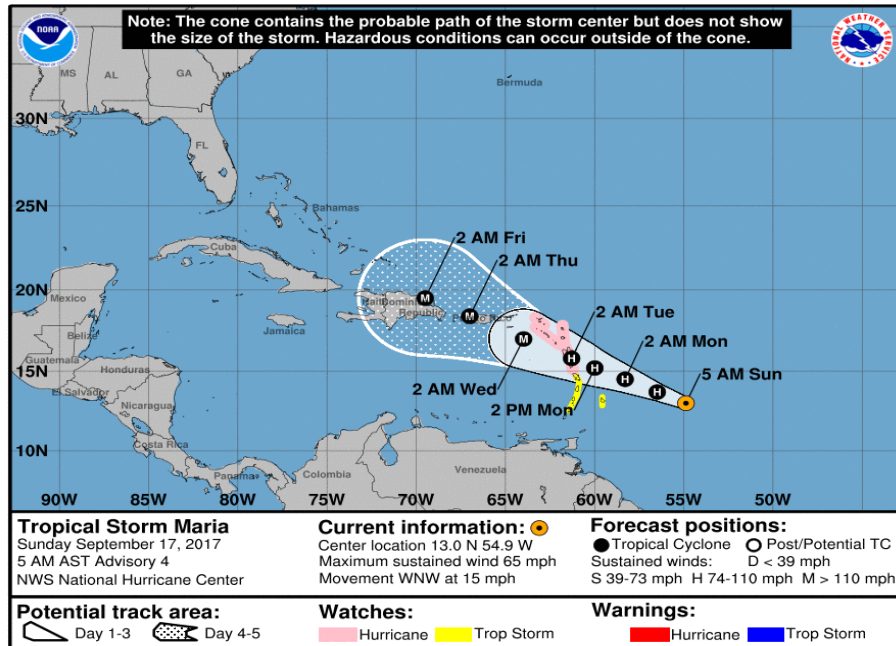
Figure 6: Example of a forecast graphic showing the cone of uncertainty (white area); showing the timing of the cyclone and the related uncertainty.

The graphic, *Most Likely Arrival Time of Tropical-Storm-Force Winds,* is more recently developed and can be used by decision makers to decide when business, schools, etc. should be closed because of high winds (Figure 7). The figure uses a color map to show the five-day chance of receiving sustained winds of 34 knots or greater; dark green indicates ~5-10% chance, whereas the purple represents a 100% chance. The storm location and wind speed are indicated by a small symbol. This graphic shows that winds will likely be expected in that location at the specified time.
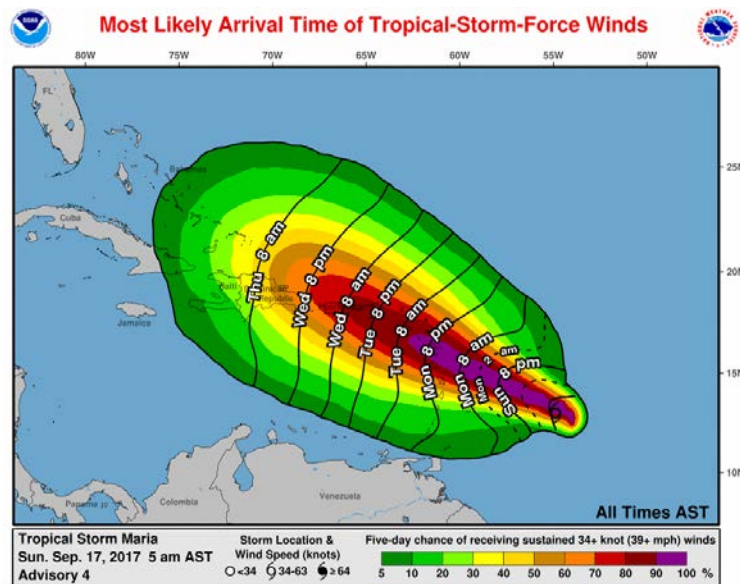
Figure 7: A forecast graphic that can be used for emergency preparedness to show the "Most Likely Arrival Time of Tropical-Storm-Force Winds".

2. *What storm surge product should be used for planning purposes?*

National Storm Surge Hazard Maps include the Maximum Envelop of Water (MEOW) and Maximum of MEOWs (MOMs). MEOWs are used operationally when narrowing decisions to a specific location, whereas MOMs are used in planning to design evacuation zones and operationally when uncertainty is high. Additionally, MOMs are used for mapping steep boundaries, when inundation is close to shore, and coastal damage is not extended inland.

Module 2: Close to Landfall

1. *How can you determine when preparation should be rushed to finish based on the arrival of tropical storm force winds?*

The graphic, "*earliest reasonable arrival time of tropical-storm force winds*", should be used to determine when preparation should be completed. By that time, individuals can safely assume that they can prepare for tropical-storm force winds. When winds are 35 knots or greater people should hunker down. Information that can be obtained from this graphic includes: (1) the expected, or most-likely time for the onset of tropical-storm force winds, and (2) that individuals may have this much time, but should not plan on using it.

2. *What is the difference between a hurricane watch and a warning?*

A hurricane warning means that conditions are expected, whereas a hurricane watch is used when conditions are possible in a specified area (e.g., sustained winds of 74 mph or higher). Hurricane warnings indicate that hurricane conditions (i.e., sustained winds of 74 mph or higher) are expected somewhere within the specified area. The hurricane warning is issued 36 hours in advance of the anticipated onset of tropical storm-force winds to allow for important preparation. A watch is issued 48 hours in advance of the anticipated onset of tropical storm-force winds in an area.

3. *What is the difference between extreme and severe WEA emergency alerts?*

Hurricanes use the word *extreme* and flash floods use the word *severe*.

4. *Which product provides a good overview of the overall tropical impacts situation?*

A Hurricane Local Statement (HLS) is a good overview of the overall tropical situation in a given CWA. It provides a summary of the worst impacts to plan for with aerial descriptions. It does NOT contain specific meteorological or threat information. It is NOT detailed for decision makers. The HLS contains a header, followed by any new information that has been issued (e.g., changes to watches and warnings), potential hazards (e.g., winds), potential impacts (e.g., structural damage), precautionary/preparedness actions or statements (e.g., evacuations) and the time that the next update will be sent out (e.g., issued by NWS for San Juan, PR around 8 PM Atlantic Standard Time (AST), or sooner, if conditions warrant).

The hurricane's threat and impacts can be found in the form of a graphic, possible threats include wind, storm surge, flooding rain, and tornados. The type of threat can be selected for a specific location using the *National Digital Forecast Database Graphical Forecasts* at weather.gov. After choosing the threat, the level will be color coded (e.g., yellow = elevated, pink = extreme). The map provides the reasonable worst-case scenario, taking into account the forecast magnitude of the hazard, along with the associated uncertainty of the forecast. Grids are available at: https://digital.weather.gov/.

Module 3: Landfall

1. *When is an Extreme Wind Warning (EWW) issued?*

It is only issued in association with major hurricanes. The criteria for an EWW is sustained surface winds of 115 mph or greater. The EWW is intended to alert the public to prepare for potentially life-threatening conditions. In the instance of Hurricane Irma, three EWW were issued by WFOSJ.

2. *What is the difference between a flash flood warning and flash flood emergency?*

A flash flood warning informs individuals that flash flooding is in progress, imminent, or highly likely. Flash flood warnings are urgent messages that dangerous flooding can develop very rapidly, with a serious threat to life and/or property (i.e., warnings issued for areas usually expect flooding). A flash flood emergency is an exceptionally rare life-threating situation (i.e., people are unaware that flooding is going to take place in that location). Examples of flash flood situations include: (1) a total failure of a major dam, (2) multiple swift water rescue teams have been or are being deployed in response to flash flooding of an exceptional magnitude, and (3) water has rapidly risen or will rapidly rise to levels where people who are ordinarily in safe locations during previous flash flood events are no longer safe.

Module 4: Post-Storm

1. *After warnings and watches have expired, what products are issued?*

WFOSJ returns to normal operations. Any weather hazard is then treated on a case-by-case scenario (e.g., flash flood warning, severe thunderstorm warning, hazard weather outlook). If required, WFOSJ will provide IDSS briefings in order to assist in the recovery process.

Scenario Overview

Using information discussed in Modules 1-4, groups were asked a series of questions when provided the necessary tools (e.g., graphics, text). All participants assumed the role of state emergency managers and were required to provide the Tropical Cyclone Formation Chance to regional emergency managers. The activity was divided into four parts: 1) Preparation, 2) Preparation and Threats-Tropical Cyclone Watches and Warnings in Effect, 3) Risk Communication, and 4) Ongoing Threats-Tropical Cyclone Watches and Warnings in Effect. Most of the questions asked during training can be found in descriptions of Modules 1-4. For the specific questions asked during this exercise, see Appendix E.

Following the exercise, the group discussed important lessons learned from the exercise or prior experience. A lesson learned from St. Croix's hurricane preparation was that school and work were cancelled the day before a major hurricane in order to encourage families to prepare. A curfew was also enforced. A major take-away from this exercise was that the HLS covers various potential hazards and threats associated with the hurricane. Prior to the storm hitting, the NWS sends out an overview of the situation, assuming that people will not have access to information updates during the storm event. For some of the potential threats; the phrase "unfolding" was used; this raised concern because it did not have a word associated with it to describe the threat level (e.g., elevated, extreme). "Unfolding" explains that the hazard is already occurring, but does not specifically describe how detrimental it will be or how conditions will change over time. Feedback from the group was that a precautionary statement should be included regarding the threat level, and that the maximum expected threat level and the expected time frame of the threat be included (i.e., "potential, elevated" or "unfolding, catastrophic").

IX.   Conclusion and Outcomes

Common themes throughout the workshop's plenary presentations and breakout group discussions were compiled and distilled into 19 lessons learned (Appendix F). Three major outcomes were identified as high priority items: 1) the need to identify vulnerable populations, 2) updating PSMAs, and 3) improving local level preparedness. Items one and two have specific end-goals and action items associated with the lessons learned, whereas, item three was broken into multiple parts, and requires extensive local, state and federal coordination.

An outcome highlighted by participants was the need to identify vulnerable populations prior to a disaster, and ensure that all hospitals have back-up power sources, multiple lines of communication (e.g., 100 Watt radios), and conduct employee training and exercises. If municipalities have not already identified vulnerable populations within their communities, then they should be identified and information should be added to contingency plans and updated regularly.

An action item included the need for more PSMAs; this would enable faster response activities and minimize duplicity of efforts at the federal and state level. Federal organizations (e.g., FEMA, NOAA) need to review existing PSMAs and potentially develop new ones in coordination with local emergency managers. Outreach to state and local level is necessary to establish what local needs are to appropriately determine mission assignments. Pre-emptively determining PSMAs would allow responders to train and prepare for assignments, ultimately resulting in a rapid response time and more damage assessment. A major lesson learned from Hurricane Maria was that areas/communities who boldly and promptly performed initial damage assessments made it easier to scope federal funding. An outcome from this workshop was therefore a need to a set a baseline for areas without one, to enable a rapid damage assessment and begin the restoration process. This could be stream lined by a standardized application used to collect assessment information for multiple sectors, establishing a centralized communication center during the assessment process, educate employees on external funding opportunities and training on grant writing and submissions.

A reoccurring theme was the need to focus disaster preparedness and planning at the community and individual level. This would include outreach programs educating community members regarding official sources of information (e.g., NWS, emergency managers), where to find information before, during and after a disaster. Setting up contacts within the community and establishing central information locations. Trainings would help community members prepare resources necessary to encourage self-sufficiency after a disaster, and educational opportunities to improve individual preparedness (e.g., rainwater harvesting). Through these outreach events and trainings, the concept of disaster readiness would remain current and at the forefront of community planning. Additionally, it would professionalize emergency management and response positions, and raise awareness around the need for emergency management curriculum at the grade school and university levels. Participants agreed these tasks will be challenging to develop, and coordination among local, state and federal levels will be necessary.

Local, state and federal disaster readiness and decision making can be enhanced by applying these lessons learned. The action items outlined by this report will help facilitate a strong emergency response network in the Caribbean region, enhance effective mission response and recovery activities, and build resilient local communities.

X. Appendices

Appendix A: Workshop and Training Agenda

Appendix B: Workshop and Training Participants

Appendix C: Workshop Presentations

Appendix D: Workshop Breakout Group Notes

Appendix E: Training Presentations

Appendix F: Conclusion and Outcomes Notes

Appendix A: Workshop and Training Agenda

NOAA Regional Preparedness Training (NRPT)

LEARNING FROM THE PAST AND MOVING FORWARD: RESPONSE* CHALLENGES FROM SEVERE WEATHER OR TSUNAMIS TO SHARED TRUST RESOURCES AND MISSION RESPONSIBILITIES

APRIL 23 – 24 – 25, 2019

U.S. EPA FACILITY, GUAYNABO, PUERTO RICO

AGENDA

DAY 1 – APRIL 23

8:00   Registration

8:30   Welcome, Background, Goals

- *Carmen R. Guerrero-Pérez, Caribbean Environmental Protection Division*
- *Charlie Henry, NOAA*
- *Nancy Kinner, Coastal Response Research Center*

9:00   Participant Introductions

9:30   Plenary Presentation: Learning from the Past – Improvements for the Future (e.g., Hurricane Maria/Coastal Flooding)

- NOAA National Weather Service - *Ernesto Rodriguez*
- USCG Mission Response - *CAPT Ricardo Alonso*
- NOAA Mission Response – *Charlie Henry and Jennifer Koss*
- FEMA – *José Marchand Parnell*
- DOI – *Debra Payton*
- US EPA – *Carlos Huertes-Hernandez, On-Scene Coordinator*
- Local Mission Response:
    - DNER – *Ernesto Diaz*
    - PREMA – *Carlos Irigoyen González*

*For the purposes of this workshop, response is a continuum from emergency response activities to recovery activities.

11:45   *LUNCH*

1:00   Overview of Scenario: Tsunami Mission and Products/Protocols –
         Christa von Hillebrandt-Andrade

2:00   Overview of Breakout Group Charge

2:15   Breakout Group - Session I

         Discussion Questions: Per the plenary sessions what
         lessons/practices/skills have been learned from the past?

4:00   Group Reports

4:30   *ADJOURN*

         ****

DAY 2 – APRIL 24

8:30   Plenary Presentation - NOAA/NWS-Weather and Forecast Products
         For Decision Makers – *Ernesto Morales, NOAA NWS*

9:30   Plenary Presentation – Risk Communication – *Carlos Irigoyen
         González, NMEAD*

9:45   Plenary Presentation – Social Media Tips - *Mirelsa Modestti González,
         PhD, Sagrado Corazón University*

10:00   *BREAK*

10:30   Breakout Group - Session II

         Discussion Questions: What needs to be done to improve/put into
         practice the previously noted 'lessons learned'? How do we improve
         for the future (with possible threat of Tsunami, big hurricane, big
         Tsunami, catastrophic event, earthquake, major oil spill, tornado)?

11:45   *LUNCH*

12:45   Group Reports

1:45   Breakout Group - Session III: The Path Forward

         Discussion Questions: What recommendations for improvement, or
         exercised, communications, implementation, coordination with
         partners, etc.

         Break

3:00   Group Reports

4:00   Closing comments including points of agreement & moving forward

4:30   *Adjourn*

****

Workshop Objectives:
1. Participants gain additional knowledge and skills to enhance risk communications before and after a damaging or disastrous tropical cyclone (hurricane) or tsunami event.
2. NOAA staff and regional partners apply lessons learned from past events to future preparedness planning creating "disaster readiness" for the safety of staff, staff families, and shared trust resources and effective mission response and recovery activities. The goal of preparedness planning is to build resilient local coastal communities on islands through gained knowledge, cross-agency and cross-regional coordination, and response/recovery planning and informed actions.

Outcomes of the NRPT Workshop:
1. With adequate information and communicated knowledge, the public and the response community will make informed decisions relative to personal protection and safety.
2. With adequate information and effective communications, responders and natural resource managers are prepared for and respond effectively to mitigate disaster impacts.

****

DAY 3 - APRIL 25, 2019

NRPT - TRAINING THEME:

What to Say and How to Say it Effectively: Fundamentals of Risk Communication and the Use of Social and Traditional Media to Enhance Communications and Messaging Before, During and After a Major Coastal Event

8:30 – 11:30   Tsunami Scenario – A Communications Exercise
Christa von Hillebrandt-Andrade

Breakout Groups to discuss and develop messaging products:

- Initial Messaging
- Intermediate Messages
- End Messages
- Recovery Message (several days post-event)

11:30 – 12:30   *Lunch provided*

12:30 – 3:30   Coastal Flooding Scenario – A Communications Exercise
Ernesto Rodriguez and Odalys Martinez

Breakout Groups to discuss and develop messaging products:

- Initial Messaging - Watch
- Intermediate Messages - Warning
- End Messages – All Clear
- IDSS - Recovery Message (several days post-event); Search & Rescue, Weather

4:00   *Adjourn*

Appendix B: Workshop and Training Participants

NOAA Regional Preparedness Training (NRPT)

LEARNING FROM THE PAST AND MOVING FORWARD: RESPONSE CHALLENGES FROM SEVERE WEATHER OR TSUNAMIS TO SHARED TRUST RESOURCES AND MISSION RESPONSIBILITIES

APRIL 23 – 24 – 25, 2019
U.S. EPA FACILITY, GUAYNABO, PUERTO RICO

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This workshop provided in partnership with NOAA's Disaster Preparedness
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Appendix C: Workshop Presentations

NOAA REGIONAL PREPAREDNESS TRAINING

1. Recognize Charlie Henry from NOAA's Disaster Preparedness Program and Nancy Kinner Director of the Coastal Response Research Center

2. Learning from the Past and Moving Forward: Challenges from Severe Natural Events to Shared Trust Resources and Mission Responsibilities
   o **Lessons Learned (ESF-10 – Chemical and Oil Spills):**
     - 19 Superfund (NPL) and 177 regulated facilities
     - Sunken and grounded vessels (377 in PR and 477 in USVI), oil, fuel, and hazardous waste removal / marine debris impacts to coral reefs (Mona case)
     - Disaster debris management and household hazardous wastes (12 million cubic yards of debris, 52% construction debris and 44% of vegetative debris) (322,148 HHW containers in PR and 145,575 containers in USVI)
     - Wastewater treatment plants and pump stations (22 WWTP of 51 out of service, 3 facilities completely flooded (Dorado, Toa Alta, and San Sebastian) and 222 pump stations out of 714 out of service / largest WW pump station in Torrecillas - Loiza had major damages with 25 MGD = sewage overflows, collapsed trunk sewers or main pump station with problems)
     - Stormwater system management (municipalities mapping and ownership, coastal flooding)
     - Restoration of water quality monitoring network / Air quality monitoring network (how safe to use surface and coastal waters (river, streams, beaches)?)
     - Sargassum accumulation

   o **Recognize our challenges and vulnerabilities:**
     - Pre-existing conditions exacerbated by the hurricanes (fiscal situation, deterioration of infrastructure, lack of maintenance, lack of resources (staff and equipment), history of non-compliance, threats from extreme weather and natural disaster events – hurricanes, drought, precipitation, sea level rise, salinity intrusion to aquifers, etc.)

   o **Moving Forward in Preparedness Planning:**
     A. Multisectoral and multidisciplinary engagement for emergency preparedness, role clarification, **"Being prepared is not a one time effort"** – continuous improvement**:**
        • Local Government (DNER, PREMA,)
        • Federal Government (NOAA, DOI, USCG, FEMA, USACE, EPA)
        • Academia (UPR, Sea Grant, CARICOOS, PR Seismic Network, American University, Sacred Heart University)
        • NGOs (Para la Naturaleza, Foundation for Puerto Rico, ISER-Caribe)
        • Private Sector (Crespo Advisors)
     B. Emergency management plans: pre-selected locations for temporary staging areas, pre-agreements with municipalities, waivers and permit pre-approvals with local and federal agencies
     C. Leveraging resources: Disaster recovery plan for PR = more than $139 billion / USVI = $7.5 billion (Federal Govt allocated approximately $45 billion)
     D. Watershed approach - Role of green infrastructure in disaster recovery (wetlands, coral reefs) as our shared Trust resources
     E. Risk communications – before, during, and after an event

   o **Thank you!**
     - Recognize EPA Staff (Sergio Bosques, Paul Fericelli and Carlos Huertas) – Thank you Sergio
     - Recognize NOAA (Charlie, Nancy and Kathy) – potential funding towards the future

WELCOME

NOAA's Regional Preparedness Training

Learning from the Past and Moving Forward:

Response Challenges from Severe Weather or Tsunamis to Shared Trust Resources and Mission Responsibilities

U.S. EPA FACILITY, GUAYNABO, PUERTO RICO

THIS WORKSHOP PROVIDED IN PARTNERSHIP WITH:
NOAA'S DISASTER PREPAREDNESS PROGRAM AND UNH COASTAL RESPONSE RESEARCH CENTER.

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Carmen Guerrero-Pérez

Caribbean Environmental Protection Division

NRPT - Puerto Rico - April 23,24,25, 2019 2

Logistics

- Fire Exits
- Restrooms
- Cell Phones/Email: "Let It Go"
- Breaks (coffee, tea, soda, water, snacks)
- Meals: on your own: local cafeterias
- Packet contents
- Logistical Questions – See Kathy Mandsager or me

NRPT - Puerto Rico - April 23,24,25, 2019 3

Coastal Response Research Center

- Partnership between NOAA's Office of Response and Restoration and University of New Hampshire (UNH)
- Since 2004
  - UNH Co-Director – Nancy Kinner
  - NOAA Co-Director – Benjamin Shorr

NRPT - Puerto Rico - April 23,24,25, 2019 4

Overall CRRC Mission

- Conduct and oversee basic and applied research and outreach on response and restoration

- Transform research results into practice

- Serve as hub for response R&D

- Facilitate workshops bringing together ALL STAKEHOLDERS to discuss spill and disaster response issues and concerns

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NOAA Regional Preparedness Trainings (NRPT)

- History/Background

NRPT - Puerto Rico - April 23,24,25, 2019 6

NRPT Workshop

THANK YOU
Participants, Group Leaders,
Recorders, Organizing Committee,
EPA Facilities, and Speakers!

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Clarifications

• For this workshop, response is continuum from emergency response activities to recovery activities.

• Response = Response + Recovery

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Workshop Objectives

- Improve knowledge and skills to enhance risk communications before and after a hurricane or tsunami
- Apply lessons learned to "disaster readiness" for:
  - safety of staff and staff families
  - shared trust resources
- Enhance effective mission response and recovery activities

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Workshop Objectives

- Preparedness planning builds resilient local coastal communities on islands through:
  - gained knowledge
  - cross-agency and cross-regional coordination
  - response/recovery planning and informed actions

NRPT - Puerto Rico - April 23,24,25, 2019 10

Workshop Outcomes

- With adequate information and communicated **knowledge,** public and response community make informed decisions relative to personal protection and safety.
- With adequate information and effective **communications,** responders and natural resource managers prepared for and respond effectively to mitigate disaster impacts.

NRPT - Puerto Rico - April 23,24,25, 2019 11

Meeting Products

- Copies of All Slide Presentations
- Workshop Report
- All Posted on CRRC Website

NRPT - Puerto Rico - April 23,24,25, 2019 12

Workshop Agenda - today

8:30   Welcome, Background, Goals

- *Carmen R. Guerrero-Pérez, Caribbean Environmental Protection Division*
- *Charlie Henry, NOAA*
- *Nancy Kinner, Coastal Response Research Center*

9:00   Participant Introductions

9:30   Plenary Presentation: Learning from the Past – Improvements for the Future (e.g., Hurricane Maria/Coastal Flooding)

- NOAA National Weather Service - *Ernesto Rodriguez*
- USCG Mission Response - *CAPT Ricardo Alonso*
- NOAA Mission Response – *Charlie Henry and Jennifer Koss*
- FEMA - *TBD*
- DOI – *Debra Payton*
- US EPA – *Carlos Huertes-Hernandez, On-Scene Coordinator*
- Local Mission Response:
  - DNER – *Ernesto Diaz*
  - PREMA – *Carlos Irigoyen González*

NRPT - Puerto Rico - April 23,24,25, 2019 13

Workshop Agenda

11:45   *Lunch*

1:00   Overview of Scenario: Tsunami Mission and Products/Protocols – *Christa von Hillebrandt-Andrade*

2:00   Overview of Breakout Group Charge

2:15   Breakout Group - Session I

Discussion Questions: Per the plenary sessions what lessons/practices/skills have been learned from the past?

4:00   Group Reports

4:30   *Adjourn*

NRPT - Puerto Rico - April 23,24,25, 2019 14

Workshop Agenda

DAY 2 – APRIL 24

8:30   Plenary Presentation - NOAA/NWS-Weather and Forecast Products
        For Decision Makers – *Ernesto Morales, NOAA NWS*

9:30   Plenary Presentation – Risk Communication – *Carlos Irigoyen
        González, NMEAD*

9:45   Plenary Presentation – Social Media Tips - *TBD*

10:00   *BREAK*

10:30   Breakout Group - Session II

        Discussion Questions: What needs to be done to improve/put into
        practice the previously noted 'lessons learned'? How do we improve
        for the future (with possible threat of Tsunami, big hurricane, big
        Tsunami, catastrophic event, earthquake, major oil spill, tornado)?

11:45   *LUNCH*

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Workshop Agenda

12:45   Group Reports

1:45   Breakout Group - Session III: The Path Forward

        Discussion Questions: What recommendations for improvement, or
        exercised, communications, implementation, coordination with
        partners, etc.

        Break

3:00   Group Reports

4:00   Closing comments including points of agreement & moving forward

4:30   *ADJOURN*

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Risk Communications Training

What to Say and How to Say it Effectively: Fundamentals of Risk Communication and the Use of Social and Traditional Media to Enhance Communications and Messaging Before, During and After a Major Coastal Event

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Training Agenda

8:30 – 11:30   Tsunami Scenario – A Communications Exercise
                Christa von Hillebrandt-Andrade

Breakout Groups to discuss and develop messaging products:

- Initial Messaging
- Intermediate Messages
- End Messages
- Recovery Message (several days post-event)

11:30 – 12:30   *Lunch provided*

NRPT - Puerto Rico - April 23,24,25, 2019 18

Training Agenda

12:30 – 3:30   Coastal Flooding Scenario – A Communications Exercise
Ernesto Rodriguez and Odalys Martinez

Breakout Groups to discuss and develop messaging products:

- Initial Messaging - Watch
- Intermediate Messages - Warning
- End Messages – All Clear
- IDSS - Recovery Message (several days post-event); Search & Rescue, Weather

4:00   *Adjourn*

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Facilitation Pledge

- I will recognize and encourage everyone to speak
- I will discourage side conversations
- I commit to:
  - Being engaged in meeting
  - Keeping us on task and time
- Stop me if I am not doing this!

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Participation Pledge

- Be Engaged
  - Turn off cell phones and computers, except at breaks
- Listen to Others
- Contribute
- Use microphones
- Speak Clearly: We will need to repeat questions for those on WebEx
- Learn from Others
- Avoid Side Conversations

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Participant Introductions

Name

Affiliation

Job

Reason for Participating in Workshop

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Breakout Session 1

- Per the plenary sessions what lessons/practices/skills have been learned from the past?

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Breakout Session 2

- What needs to be done to improve/put into practice the previously noted 'lessons learned'? How do we improve for the future (with possible threat of Tsunami, big hurricane, big Tsunami, catastrophic event, earthquake, major oil spill, tornado)?

NRPT - Puerto Rico - April 23,24,25, 2019 24

Breakout Session 3

- What recommendations for improvement, or exercises, communications, implementation, coordination with partners, etc.

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Workshop Website

https://crrc.unh.edu/NRPT_PuertoRico

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Thank you

Nancy Kinner
UNH Coastal Response Research Center

NRPT - Puerto Rico - April 23,24,25, 2019 27
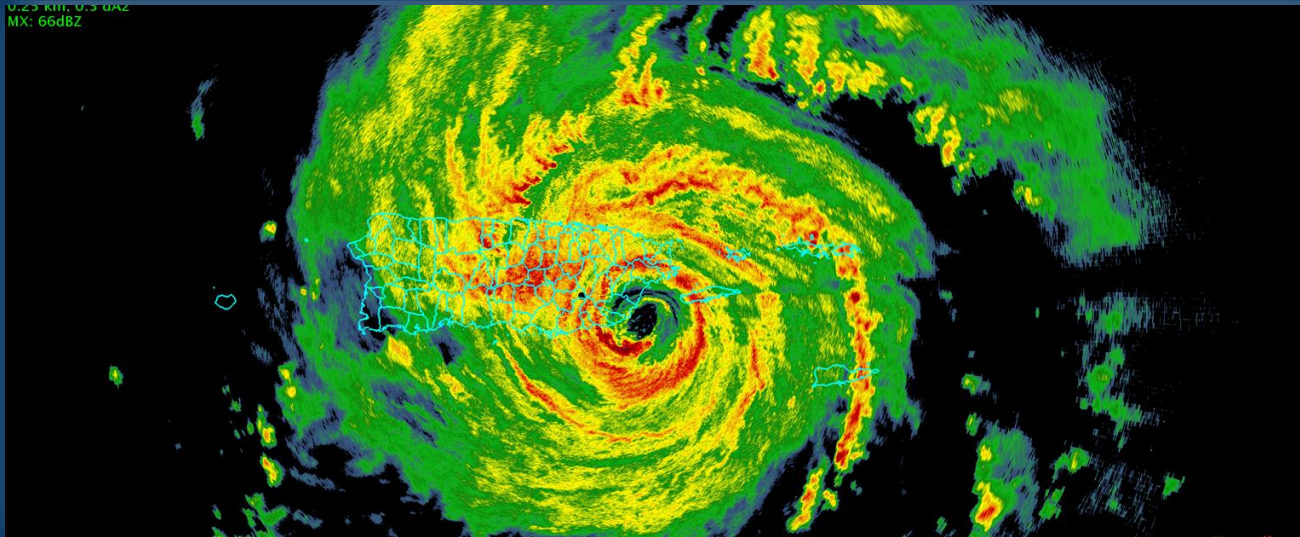
Learning from the Past, Improvement for the Future

NOAA National Weather Service
WFO San Juan

Ernesto Rodriguez
Science and Operation Officer

Outline

Mission and Vision
National Weather Service

Hurricane Maria
From the National Weather Service's Perspective

Lessons learned after Hurricane Maria
Major Hurricane Maria

Improvement for the Future
Tailored forecast through Impact Decision Support Services

National Weather Service

MIssion and Vision

Mission:

Provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy.

Vision:

A Weather-Ready Nation Society is prepared for and responds to weather, water, and climate-dependent events.

Building TRUST

NWS San Juan build trust with decision makers of U.S. Virgin Islands and Puerto Rico through **table top, full-scale exercises and outreach activities** before the Hurricane Season.

Pre-event COORDINATION

Briefings with the Puerto Rico and the U.S. Virgin Islands state and federal agencies.

Core Partners use the information provided by the National Weather Service San Juan to make critical decisions.

NWS Internal
COORDINATION

- Numerous coordination calls with the **National Hurricane Center**, **Weather Prediction Center** and the **Southeast River Forecast Center** were made before the hurricane affected the warning area.

- **Conference calls and planning meetings** with Southern Region and WFO Miami.

HURRICANE MARIA
SEPTEMBER 20, 2017

Thankfully the worst case scenario did not happen with Hurricane Maria

* GOES-16 CH-13-10.35um   Wed 10:00Z 20-Sep-17

noaa_nws.png

Imagine Irma with sustained winds of 185 MPH moving over Puerto Rico
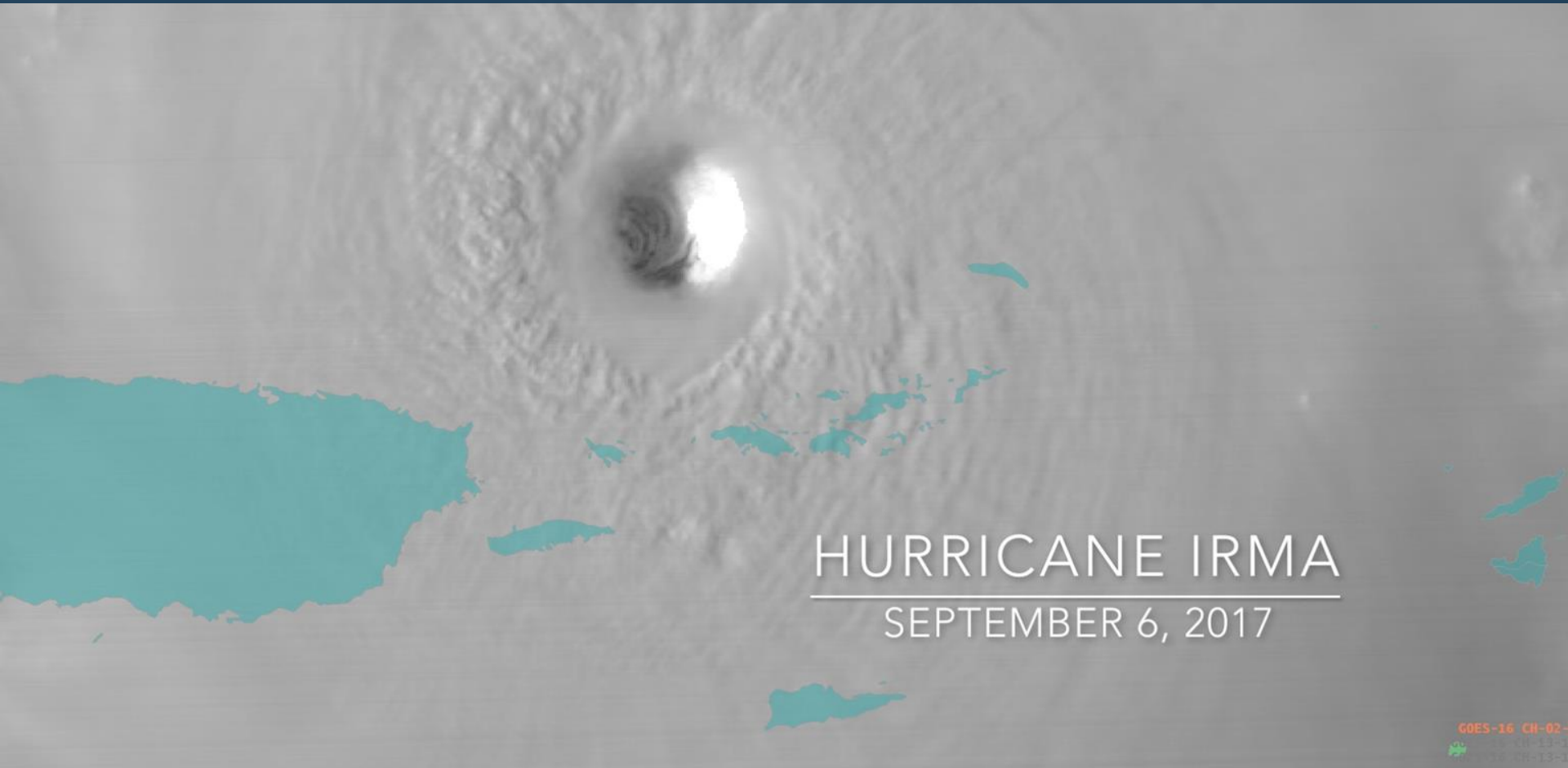
HURRICANE IRMA
SEPTEMBER 6, 2017

GOES-16 meso-sector

- 16 channels
- 1-min imagery
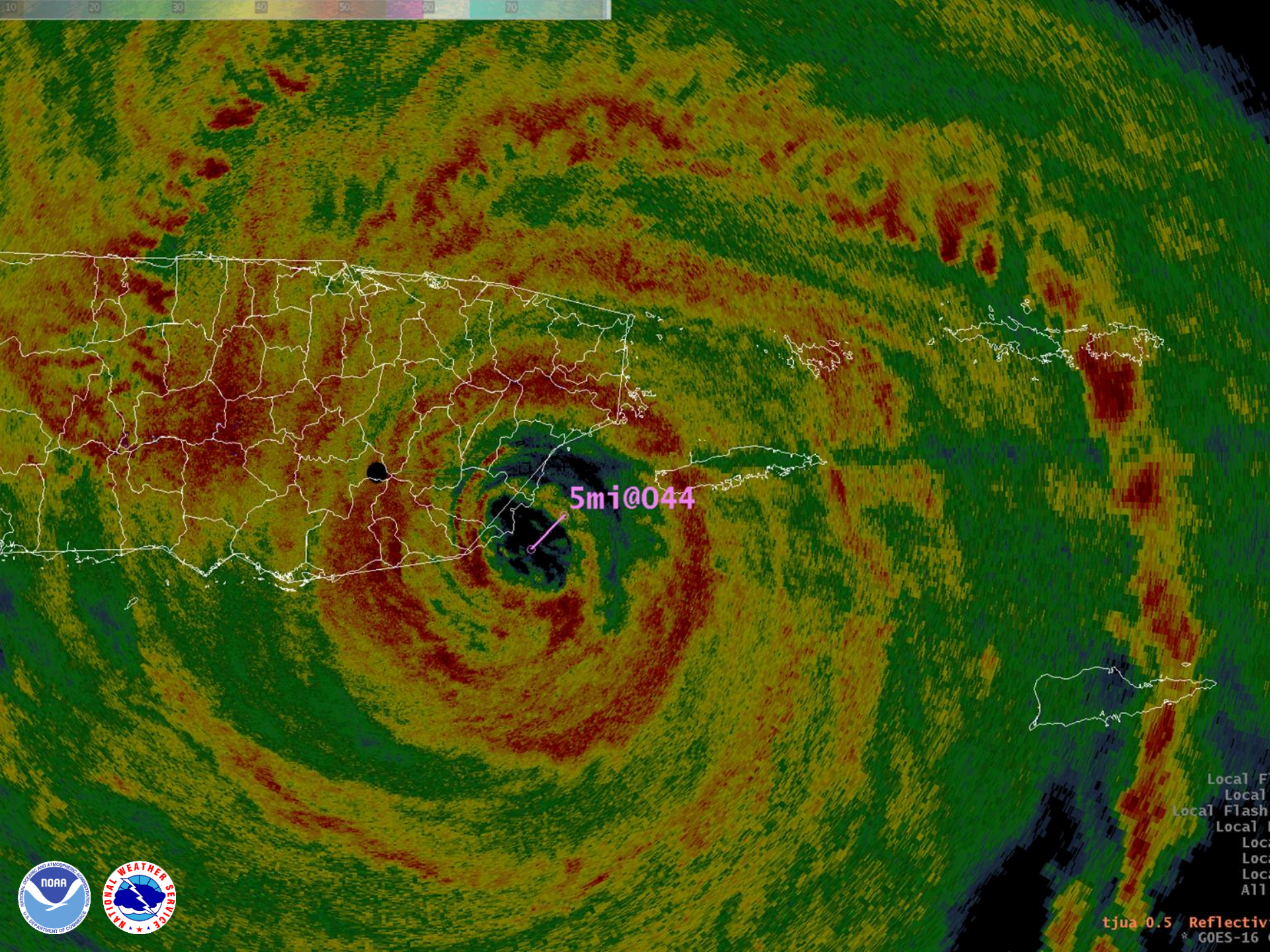
5mi@044

tjua 0.5 Reflectiv
* GOES-16
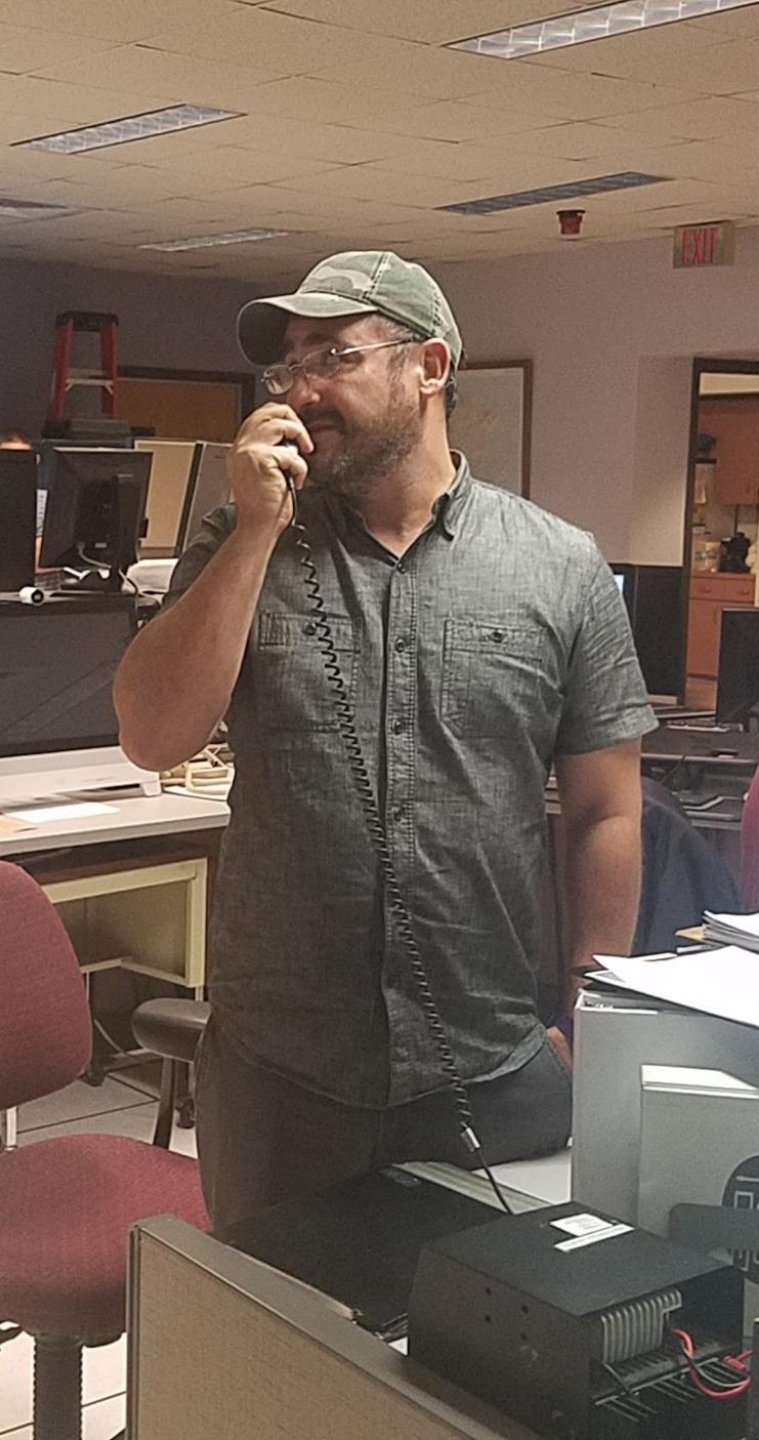
AFTER
Communications Failed

Utilized two way radio and satellite phones to get information on the flooding situation.

Forecasters at the Emergency Operation Center kept updating our core partners.

After failed attempts to reach out the public, the office contacted the only radio station working at that time to brief the public on current situation and forecast.

IDSS are forecast advice and interpretative services the NWS provides to help core partners, such as emergency personnel and public safety officials, make decisions when weather, water and climate impacts the lives and property.

This support may be needed in response to a particular event or routinely to support high-value decision making.

USCG Sector San Juan

ENVIRONMENTALLY SOUND, MONA ISLAND

Enhance climate services to help communities, businesses, and governments understand and adapt to climate-related risks

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@NadeshaWAPA
@Nael Fontan
@Yarim Correa
@waltersotoleon
@Ektor79
@Jose Soto Anglero
@Edgar Rodriguez

U.S. Coast Guard

NOAA Regional Preparedness and Training Workshop

Response Challenges from Severe Weather and/or Tsunamis

Office of Marine Environmental Response Policy (CG-MER)
CAPT Ricardo Alonso
Apr 23, 2019

Authorities

Statutory Authorities

- Federal Water Pollution Control Act (FWPCA) as amended by CWA (1972)
  - Oil Pollution Act (OPA90)
  - Oil Spill Liability Trust Fund
- Comprehensive Environmental Response Compensation Liabilities Act (CERCLA)

Regulatory Authority

- 40 CFR 300 National Contingency Plan

MEP & MER Missions

Marine Environmental Protection

- Regulate the discharge of oil, HAZSUB, and other shipboard wastes into U.S. and international waterways

- Protect marine life and ecosystems

- Regulate invasive species into U.S. waterways

Marine Environmental Response

- Respond to oil and hazardous substance incidents

- Develop environmental regulations and standards

Federal On Scene Coordinator

FOSC Roles & Responsibilities IAW NCP:

- Provides access to federal resources and technical assistance

- Coordinates all federal containment, removal, and disposal efforts and resources during an oil spill or hazardous material release

- Coordinates, monitors, and directs response efforts

On-Scene Coordinator

- Predesignated official responsible to coordinate and direct responses to oil discharges and hazardous substance releases
- Provides access to federal resources and technical assistance

- Coordinates all federal containment, removal, and disposal efforts and resources during an oil spill or hazardous material release
- Coordinates, monitors, and directs response efforts, including responsible party

MISSIONS DURING DISASTER RESPONSE

Saving lives in distress and ensuring the safety and survivability of USCG forces and assets

Security and reconstitution of ports, waterways, and critical maritime infrastructure

Environmental response operations (oil, chemical and HAZMAT)

Support to other agencies in a whole of government response effort

6

3

Preparedness

Internal

- Heavy Weather/Disaster Plans
- Exercises (local and District)
- Personnel and equipment preps
- Pre-stage

External

- Area Contingency Plan
- Exercises (critical to meet/know players early for familiarity, resources, needs, vulnerabilities)

National Contingency Plan

40 CFR § 300.205(g)

National Response System

1. Reports also shared with NOC to support situational awareness.
2. This includes local and Tribal representatives as well.
3. Resources available to support the OSC upon request.

9

NRF & NCP

5

NRS Assets

On-Scene Coordinators (OSCs)

Coordinate all containment, removal, and disposal efforts/resources.

Other NRS components

– National Response Center
– USCG Strike Teams
– Area Committees
– State/Local Governments
– Special Teams
– Private Sector
– Joint Response Teams with neighboring countries

Responsibilities and Organization

National Response Team (NRT)

The NRT is responsible for national response and preparedness planning, for coordinating regional planning, and for providing policy guidance and support to the RRTs
40CFR300.105 (c) (1)

13 Regional Response Teams (RRTs)

The RRTs are responsible for regional planning and preparedness activities before response actions, and for providing advice and support to the OSC or RPM when activated during a response.
40CFR300.105 (c) (2)

NRT Mission

To provide technical assistance, resources and coordination on preparedness, planning, response and recovery activities for emergencies involving hazardous substances, pollutants and contaminants, hazmat, oil, weapons of mass destruction in natural and technological disasters and other environmental nationally significant incidents.

Activating the National Response Team

- The NRT should be activated as an emergency response team when:
    - Oil or HAZMAT discharge exceeds the capability of the Region in which it occurs;
    - Transects National Boundaries;
    - The threat to public health, property, or natural resources is substantial
  [Reference: 40CFR300.110 (j)]

  **The NRT may also be activated to support an ESF-10 response, even if the three previous criteria have not been met

INCIDENT TIMELINE

PRE-INCIDENT

- Pre-stage resources through **SURGE ACCOUNT**
- **NATIONAL/REGIONAL RESPONSE COORDINATION CENTER** activated
- [NATIONAL/REGIONAL] **INCIDENT MANAGEMENT ASSIST TEAM** arrives on scene
- POTUS approves **EMERGENCY DECLARATION**

RESPONSE

INCIDENT

- POTUS approves **MAJOR DISASTER DECLARATION**
- **MISSION ASSIGNMENTS** issued to/executed by Federal Agencies

RECOVERY

- **JOINT FIELD OFFICE** established and assumes on scene Incident Management and Support
- **NATIONAL/REGIONAL RESPONSE COORDINATION CENTER** deactivated

15

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EMERGENCY SUPPORT FUNCTIONS

ESF		
ESF 1	TRANSPORTATION	SUPPORTING AGENCY
ESF 2	COMMUNICATIONS	
ESF 3	PUBLIC WORKS AND ENGINEERING	SUPPORTING AGENCY
ESF 4	FIREFIGHTING	SUPPORTING AGENCY
ESF 5	INFORMATION AND PLANNING	
ESF 6	MASS CARE, EMERGENCY ASSISTANCE, TEMPORARY HOUSING, AND HUMAN SERVICES	
ESF 7	LOGISTICS	
ESF 8	PUBLIC HEALTH AND MEDICAL SERVICES	SUPPORTING AGENCY
ESF 9	SEARCH AND RESCUE	PRIMARY AGENCY
ESF 10	OIL AND HAZARDOUS MATERIALS RESPONSE	PRIMARY AGENCY
ESF 11	AGRICULTURE AND NATURAL RESOURCES	
ESF 12	ENERGY	
ESF 13	PUBLIC SAFETY AND SECURITY	SUPPORTING AGENCY
ESF 15	EXTERNAL AFFAIRS	

16

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NRF COORDINATING STRUCTURES

NATIONAL COMMAND CENTER (NCC)

DHS NATIONAL OPERATIONS CENTER (NOC)

NOC WATCH

INTELLIGENCE WATCH

NATIONAL RESPONSE COORDINATION CENTER (NRCC)

FEMA NATIONAL WATCH CENTER (NWC)

NATIONAL INFRASTRUCTURE COORDINATION CENTER (NICC)

CG LANTAREA

CG PACAREA

REGIONAL RESPONSE COORDINATION CENTER (RRCC)

STATE/TERRITORY EMERGENCY OPERATIONS CENTER (EOC)

- CGD ONE
- CGD FIVE
- CGD SEVEN
- CGD EIGHT
- CGD NINE

- CGD ELEVEN
- CGD FOURTEEN
- CGD THIRTEEN
- CGD SEVENTEEN

- **Region I** (Boston, MA)
- **Region II** (New York, NY)
- **Region III** (Philadelphia, PA)
- **Region IV** (Atlanta, GA)
- **Region V** (Chicago, IL)
- **Region VI** (Denton, TX)
- **Region VII** (Kansas City, MO)
- **Region VIII** (Denver, CO)
- **Region IX** (Oakland, CA)
- **Region X** (Seattle, WA)

JOINT FIELD OFFICE (JFO)

17

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SITUATIONAL AWARENESS

CG LNO (NRCS)
COMDT (CG-CPE)

Manage overall CG NRCC support

Coordinate Mission Assignment process

Manage all CG situational awareness and reporting

Coordinate CG participation in meetings

Facilitate Requests For Information

ESF 1 – TRANSPORTATION
COMDT (CG-FAC)

ESF 9 – SEARCH AND RESCUE
COMDT (CG-SAR)

ESF 10 – OIL/HAZMAT RESPONSE OPERATIONS
COMDT (CG-MER)

Coordinate with CGHQ program offices

Leverage internal network to produce more detailed situation reporting

Coordinate with NRCC Logistics to determine (and anticipate) resource needs

Facilitate requests for CG resources

Coordinate closely with CG LNO

18

Response Management

Key points:

- EPA and USCG coordinate and direct the response, EPA for inland areas, USCG for the coastal zone.

- Other federal agencies with appropriate jurisdiction and expertise support the lead agency.

- Activities are done in partnership with state and local officials.

- Industry is responsible for being prepared for, responding to, and paying for cleanup and damages from pollution incidents when they are designated the PRP.   Additionally, industry may work with the government as an OSRO/Contractor.

- The NRS uses the National Incident Management System/Incident Command System to bring these parties together to manage response actions.

Coast Guard National Strike Force

- National Oil & Chemical Response Capability
- Support On-Scene Coordinators, Other Agency Incident & Combatant Commanders
    - National Strike Force Coordination Center
    - Atlantic, Pacific, and Gulf Strike Teams
- Reorganization:
    - CG Incident Management & Assist Team
    - Public Information Assistance Team

2016 Budget:	$3.4M
FTE (IMAT & PIAT):	161
Yearly Responses:	~45
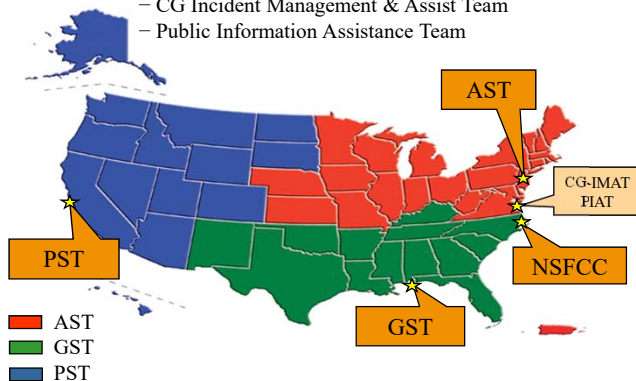
AST
CG-IMAT PIAT
PST
NSFCC
GST

- AST
- GST
- PST

Response & Recovery Challenges

- **<u>Interagency Coordination</u>** – NRS, NRF and NRT

- **<u>Communications</u>** – Ability to rapidly setup comms for interagency coordination

- **<u>Logistics</u>** – Response dependent on logistics, surge forces and equipment

- **<u>Infrastructure</u>** – Critical for survivors & responders

"Critical Needs During a Response Always include Public-Private Partnerships (PPP)"

21

Recent Hurricane Lessons Learned

- **<u>MRO / Flood Response</u>:** CG flood response assets such as the Western River Flood Punt teams were extensively utilized during Harvey and Irma. Several issues were identified relating to the best platform to use, equipment, communications, logistics, and qualifications. CG-731 (Boat Forces) convened a workgroup to examine these issues.

- **<u>Satellite Phones</u>:** Due to limited range of VHF radios, 800 MHz radios, and damaged cell phone towers, satellite phones capable of placing and receiving phone calls should be utilized. Verify with the manufacturer that satellite phones are able to place/receive phone calls. Provide IMT with user guide/training for satellite phones.

- **<u>IT Support</u>:** A lack of IT support hampered IMT interoperability at the ICP.

- **<u>NOAA SSC</u>:** Confusion arose regarding funding SSCs deployed to Sectors to conduct hurricane flood modeling and imagery interpretation because Sectors were unsure how to fund the SSC beyond the scope of a pollution response. **Recommendation:** *Review existing NOAA-USCG IAA and develop a funding and deployment process exclusively for non-pollution-related weather events.*

22

11

Recent Hurricane LL (continued)

Summary of Lessons Learned:
- Maximize the use of resources (such as ombudsmen and auxiliary) to enhanced alignment with partner agencies' goals and FEMA-District-Sector coordination when deploying EPLOYs, LNOs and AREPs to EOCs.
- Documented a surge in the use of Flood Punt Teams to conduct urban SAR
- Provide ESF-10 and Mission Assignment training
- Provide training on use of UAS
- Plan for and execute exercises spanning across multiple Districts and AORs
- Ensure Personnel Support Teams (PSTs) are adequately staffed to manage call volume for accountability of CG members and family. **Best Practice:** *Test phone numbers ahead of hurricane season.* **Recommendation:** *Create a PST App for Smartphones.*
- Leverage External Agencies: The inclusion of the National Hurricane Marine Branch in the response yielded valuable tidal and wind information that informed key decision-makers during the 2018 hurricane season. Continual engagement pre and post hurricane season will benefit future responses.

23

Questions?

CAPT Ricardo Alonso
(202) 372-2232
Ricardo.M.Alonso@uscg.mil

24

NOAA Caribbean overview

April 23-25, 2019

NRPT Meeting

NOAA in the Caribbean

▶ Mission

- ▶ NOAA in the Caribbean (NOAA Carib) is a forum for communication, partnership, and user engagement that supports the delivery of the agency's mission in the domestic and international Caribbean.

▶ Goal

- ▶ Identify and respond to local and regional challenges, needs, and opportunities in the Caribbean region by increasing communication and providing a platform that connects NOAA, its core partners, and key users in the region.

NOAA in the Caribbean

- ▶ Guiding Principles
  - ▶ Share information within NOAA and with external partners regarding engagement in the region and the products and services NOAA offers.
  - ▶ Enhance stakeholder communication with NOAA personnel and access to NOAA resources and capabilities.
  - ▶ Serve as a connecting link between NOAA headquarters and line offices, and NOAA activities in the Caribbean region.
  - ▶ Improve collaboration among NOAA and its regional partners.
  - ▶ Stress the application of "an integrated NOAA approach", where NOAA employees understand and are knowledgeable about NOAA activities in the region, and look for opportunities to provide additional value to efforts through integration.
  - ▶ Facilitate implementation of the NOAA Caribbean Strategy via alignment of NOAA Carib activities, protocols, and membership.

National Weather Service

The National Weather Service provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas.

- ▶ **Caribbean Tsunami Warning Program (CTWP)** – *Tsunami and Seismic Data, Educator Resources, Student Opportunities*
  - ▶ *The CTWP office supports an increased capability of the tsunami warning system for the Caribbean and Adjacent Regions. This includes the observational system (sea level, seismic and GPS) and the continued enhancement of tsunami outreach and education capacity, including the implementation of the TsunamiReady® (US) and Tsunami Ready (International) Programs.* **Located in Mayagüez, Puerto Rico**

- ▶ **National Hurricane Center (NHC)** – *Educator and Student Resources, Tours, Hurricane Information and Data*
  - ▶ *The mission of the NHC is to save lives, mitigate property loss, and improve economic efficiency by issuing the best watches, warnings, forecasts, and analyses of hazardous tropical weather and by increasing understanding of these hazards.* **Located in Miami, FL**

National Marine Fisheries Service

The NOAA Fisheries Service is dedicated to the stewardship of living marine resources through science-based conservation and management, and the promotion of healthy ecosystems. They have regional offices and several smaller field offices.

▶ Northeast Marine Corridor and Culebra Island Habitat Focus Area

  ▶ As part of the Habitat Blueprint administered by the NOAA Fisheries Office of Habitat Conservation, NOAA has selected ten Habitat Focus Areas (HFAs), place-based locations across the country to maximize the effectiveness of habitat conservation. In Puerto Rico, NOAA developed an implementation plan and associated action plans for the The Northeast Marine Corridor and Culebra Island Habitat Focus Area in Puerto Rico.

  ▶ Primary activities are to restore threatened corals, implement watershed restoration projects, research fishery and recreational impacts to fragile marine ecosystems, and improve the predictions of real-time storm surge, to conserve this area's coral reefs, seagrass beds, mangroves, and the people and animals that depend on them.

National Ocean Service

The National Ocean Service provides data, tools, and services that support coastal economies and their contribution to the national economy.

▶ **National Estuarine Research Reserve System** – *Field Trips, Professional Development, Educator Resources*

  ▶ *The National Estuarine Research Reserves System protects more than 1.3 million coastal and estuarine acres in 28 reserves located in 22 states and Puerto Rico for purposes of long-term research, environmental monitoring, education and stewardship.* Jobos Bay Reserve

▶ **Integrated Ocean Observing System (IOOS)** – *Curriculum, Real World Data, and Multimedia*

  ▶ *The Caribbean Coastal Ocean Observing System (CariCOOS) operates a network of observing assets including data buoys, coastal meteorological stations, vessels, instruments and radars. Data from these assets and value-added data products such as graphs and maps are provided free of charge to the general public on their website.*

National Environmental Satellite, Data, and Information Service

NESDIS provides secure and timely access to global environmental data and information from satellites and other sources to promote and protect the Nation's security, environment, economy, and quality of life.

▶ **Caribbean Atmospheric Research Center ("Atmos Carib")** – *Satellite Data, Forecasts, Local Climatology*

  ▶ *Atmos Carib is affiliated with the National Climate Data Center and aims to offer the most comprehensive weather and climate information for the Caribbean Region.* **Located in Mayagüez, PR**

Oceanic and Atmospheric Research

NOAA Research provides the research foundation for understanding the complex systems that support our planet.

▶ *Sea Grant is a nationwide network of 32 university-based programs that conduct scientific research, education, training, and extension projects designed to foster science-based decisions about the use and conservation of our aquatic resources.*

NOAA Regional Preparedness Training (NRPT) Workshop

San Juan, PR
23 April, 2019

Charlie Henry, Director
Disaster Response Center
Mobile, AL

1

NOAA | Office of Response and Restoration

NOAA HEADQUARTERS ORGANIZATION

CORPORATE FUNCTIONS

Acquisition & Grants

Chief Administration Officer

Chief Financial Officer

Under Secretary of Commerce for Oceans & Atmosphere & Administrator

Deputy Under Secretary of Operations

General Counsel

Chief Information Officer

Program Planning & Integration

Workforce Management

LINE OFFICES

| National Marine Fisheries Service (NMFS) | National Ocean Service (NOS) | National Environmental Satellite, Data, & Information Service (NESDIS) | Oceanic & Atmospheric Research (OAR) | National Weather Service (NWS) | Office of Marine and Aviation Operations (OMAO) |

2

NOAA | Office of Response and Restoration

NOAA Primary Mission Assignments:

PMEF #1: Collect and provide the Nation with critical intelligence data, imagery, and other essential information for predictive environmental and atmospheric modeling systems and space-based distress alert systems by operating NOAA-controlled satellites, communications equipment, and associated systems.

3

NOAA | Office of Response and Restoration

NOAA Primary Mission Assignments:

PMEF #2: Provide the Nation with environmental forecasts, warnings, data, and expertise critical to public safety, disaster preparedness, all-hazards response and recovery, the national transportation system, safe navigation, and the protection of the Nation's critical infrastructure and natural resources.

4

NOAA | Office of Response and Restoration

NOS FEMA Pre-Scripted Mission Assignments:
- **Coastal science support coordinator (FOS)**
- **Geodetic surveys**
- **Aerial imagery/LIDAR**
- **Hydrographic surveys**
- **Scientific support for oil and chemical spills**
- **Marine debris assessment**

NOS FEMA Pre-Scripted Mission Assignments:
**-Could be just about anything from response
through recovery.**

5

NOAA | Office of Response and Restoration

…each office in NOS provides some role in disaster response.

6

4/25/2019
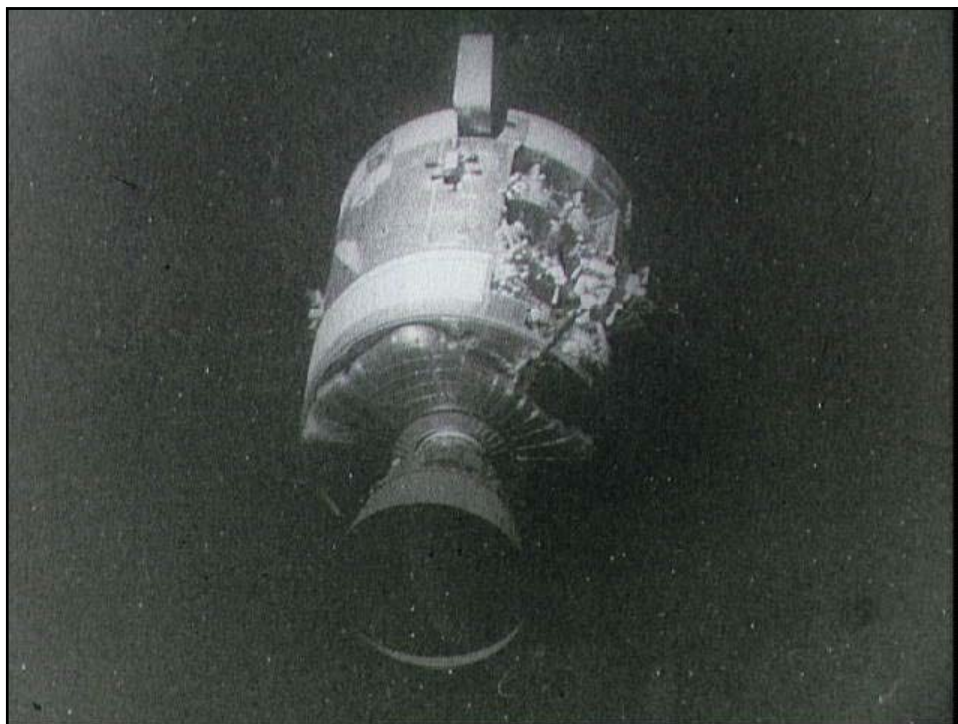
NOAA | Office of Response and Restoration

(my program office)
Office of Response and Restoration
Our Mission and Mandates

To provide world-class science and information-based solutions to protect and restore the nation's resources and their uses from coastal environmental hazards.

8

4

A bit of history…
Origins of NOAA "HAZMAT" Program…

1970   NOAA Created

1976   *Argo Merchant* oil spill,
         Nantucket, MA

1977 – Special Force in the NCP

Scientific Support to FOSC
Scientific Support Coordinators

NOAA's Office of Response and Restoration (OR&R)
     "We have been part of the science of oil and chemical spills for a very long time."

NOAA | Office of Response and Restoration

Annually, OR&R…

- provides 24/7 support for emergency response support.
- responds to 120-170 oil & chemical spills.
- trains more than 2000 emergency responders and planners.
- supports over 40 spill drills with the U.S. Coast Guard and other agencies.
- settles 4-7 natural resource damage assessment cases & works on over 200 additional cases.
- supports removal of hundreds of tons of marine debris.
- develops new tools & conducts research to address hazards on the water and prevent marine debris.
- …and respond to disasters.

         (small program office, big job)

10

Leveraging Science to Solve Problems during Emergency Events

Chemical Spills
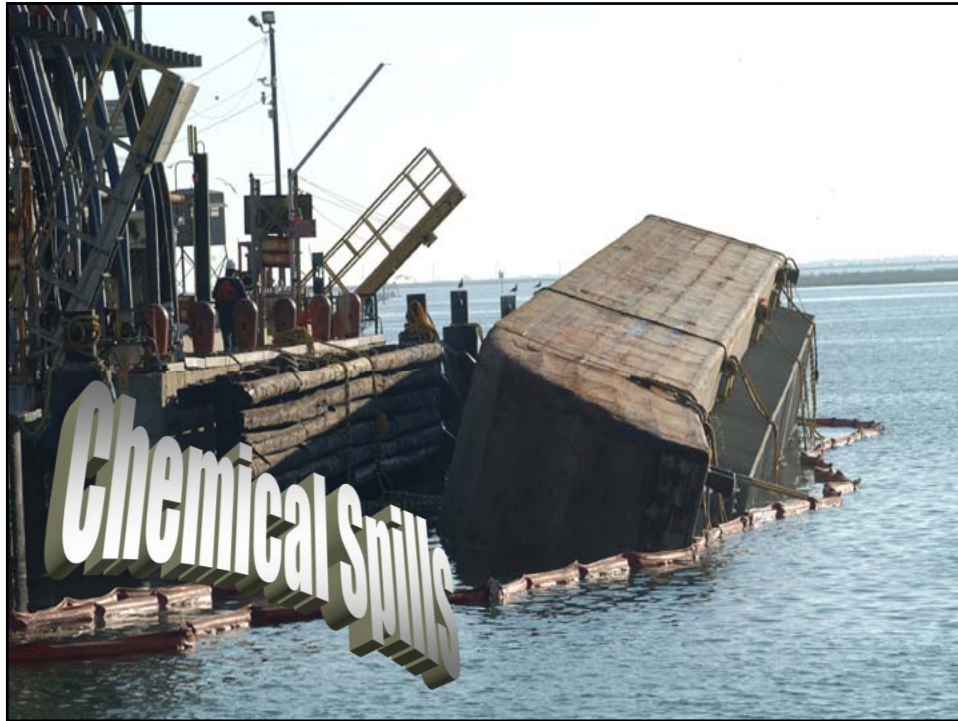
Damage Assessment and Restoration

Marine Debris

BAD WEATHER
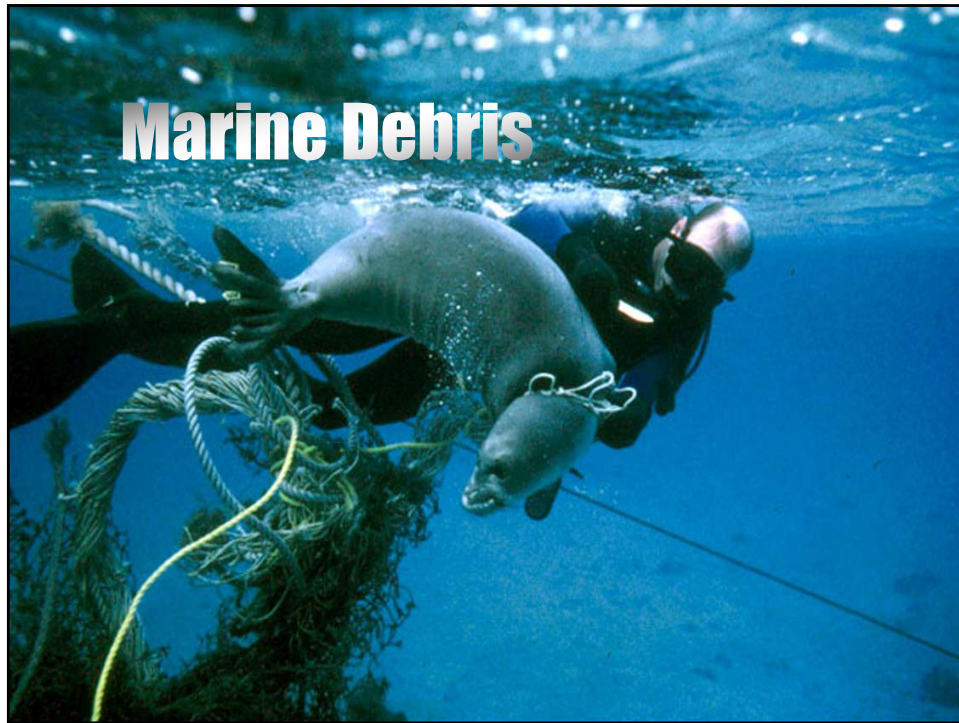
The origins of the NOAA GOM Disaster Response Center started with a storm in the Gulf of Mexico…
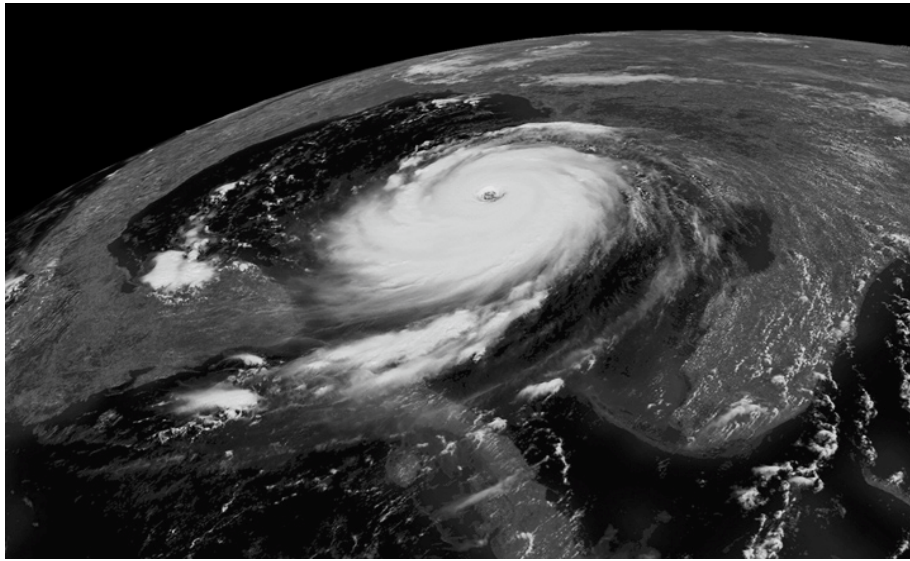
Disaster Response Program
DRC – A Hub for Gulf of Mexico Coordination
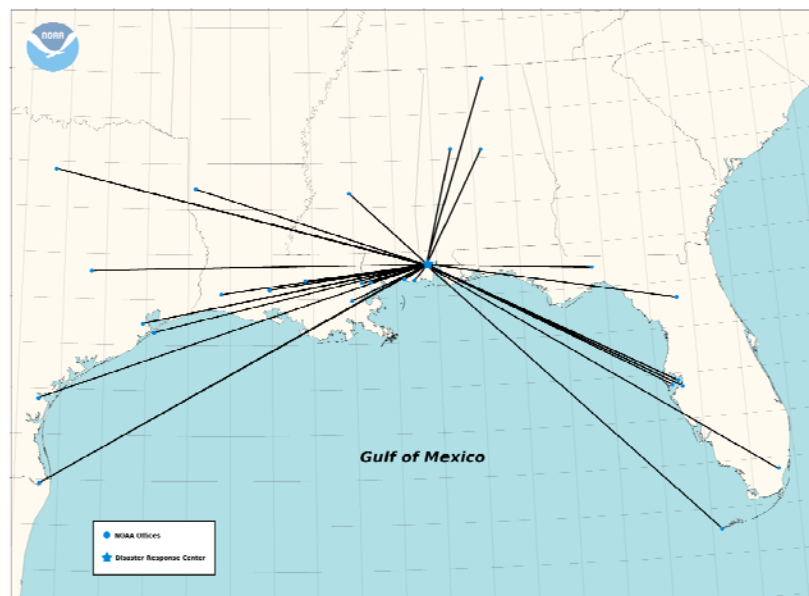
NOAA
Gulf of Mexico Disaster Response Center (DRC)
All-Hazards Preparedness Mission
Disaster Preparedness Program

18,700 sq-ft hardened complex (up to cat. 5)

Dedicated on 15 Oct. 2012 – Supporting Hurricane Isaac the Next Day

FEMA-4339-DR-PR
Capacity Building
Sector

CAPACITY BUILDING SECTOR

Mission

Provide the essential support, guidance, and tools to the whole community, including Federal, Commonwealth, Municipal, Private Sectors, and NGO partners to build upon, restore and strengthen their capability and capacity as entities and individuals to be prepared and able to perform their essential functions effectively, efficiently, and *sustainably* in response and recovery efforts.

TRANSFORMATION AND INNOVATION IN THE WAKE OF DEVASTATION
AN ECONOMIC AND DISASTER RECOVERY PLAN FOR PUERTO RICO

PARTNERS AND RESILIENCE PROGRAMS

Recovering on a different perspective. A Better preparedness will support a faster recovery

Recovery / Resilience Partners

COR3 - Partners in the Resilience:

- Puerto Rico Emergency Management Agency Bureau
- Puerto Rico Planning Board
- 78 Local Emergency Management Offices

- Local Government Agencies
- Other Federal Agencies
- Non Governmental Organizations

Units / Programs

- Community Resiliency / Preparedness
- Continuity of Operations
- Training & Exercise
- Mass Care

- Hazard Mitigation Community and Education Outreach
- Hazard Mitigation Community Planning
- Community Planning Capacity Building - RSF

FEMA

Innovations

FEMA

INNOVATIONS
- PR-IMT National Qualification System (MOA).
- Lifeline State Integration
- Youth Preparedness Council.
- Core Advisory Groups.
- Multisectoral Disaster Feeding Plan
- Business EOC.
- Reverse Engineering on Soft Projects.
- Technical Assistance for Partners.
- Hazard Mitigation Planning
- Municipal and Regional Baseline Assessments.
- Preparedness & Mitigation Curriculum for Schools
- Relaunch of CERT (Community Approach & Schools).
- PR Agency COOP Plans and EOPs
- Community Preparedness Outreach

Questions & Discussion

Challenges, Innovation, the way forward

Natural and Cultural Resources (NCR) Recovery Support Function (RSF)

Responsibilities, Efforts and Lessons Learned

Learning from the Past and Moving Forward
23 April 2019
Debbie Payton/DOI
NCR RSF – Hurricane Maria

Background

- DOI/RSF new role for me
- Speaking ONLY from DOI/RSF perspective; no explicit or implied FEMA representation
- Puerto Rico/USVI experience
- Lessons are evolving

National Preparedness System

FROM FEMA NDRF, 20
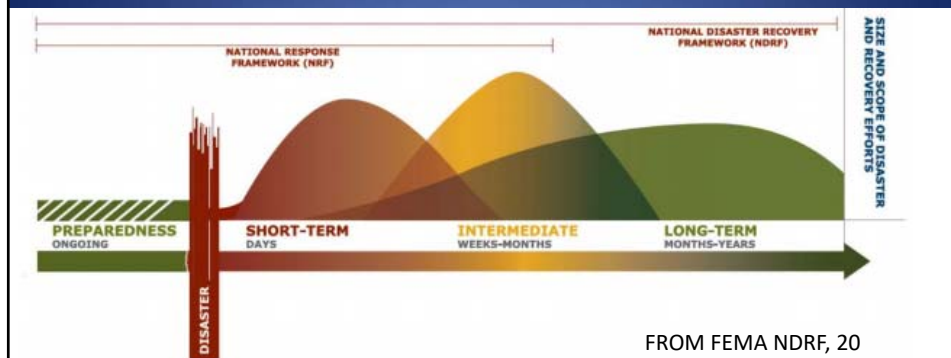
Five frameworks:
Prevention, Protection, Mitigation, Response, Recovery

Natural and Cultural Resources
Core Capability

- Objective: Protect natural and cultural resources and historic properties through appropriate …….. actions to preserve ……… and restore them consistent with post-disaster community priorities and best practices and in compliance with applicable environmental and historic …… laws and ……… orders.

- Delivered:

  Natural and Cultural Resources Recovery Support Function

NCR RSF TEAM – Primary Agencies

Department of the Interior – Coordinating Agency

Federal Emergency Management Agency

Environmental Protection Agency

National Oceanic and Atmospheric Administration

5

Supporting Agencies

- U.S. Department of Agriculture (USDA)
- Council on Environmental Quality (CEQ)
- U.S. Department of Commerce (DOC)
- U.S. General Services Administration (GSA)
- Corporation for National and Community Service (CNCS)
- Heritage Emergency National Task Force (HENTF) – Smithsonian Institute

6

Other Supporting organizations

- Advisory Council on Historic Preservation (ACHP)
- Institute of Museum and Library Services (IMLS)
- Library of Congress (LOC)
- National Archives and Records Administration (NARA)
- National Endowment for the Arts (NEA)
- National Endowment for the Humanities (NEH)
- U.S. Army Corps of Engineers (USACE)

7

Cultural Resources Definition

- Aspects of a cultural system that are valued by or significantly representative of a culture or that contain significant information about a culture
- Cultural resources may be tangible entities or intangible cultural practices

8

Cultural Resources

Archeological/Archaeological Sites
Submerged Cultural Resources
Built Environment (Buildings & Structures)
Traditional Cultural Properties (TCPs)
Landscapes
Burial Sites/Cemeteries
Objects, Collections, and Records
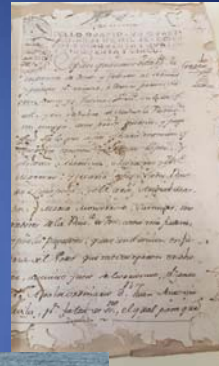
9

Cultural Resources as Critical Facilities

- Critical Facilities definition in Stafford Act includes Cultural resources
- Libraries, Museums, non-profits
- May be eligible for FEMA Public Assistance

10

Traditional Cultural Property

A traditional cultural property can be defined generally as one that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the
continuing cultural identity of the community.

Objects, Collections, and Records

- An **object** is an item or artifact with artistic, educational, historic, scientific, or social importance to a community.
- **Collections** are a group of objects with some unifying characteristic, or that have been assembled from a variety of sources.
- **Records** are documentary materials, regardless of physical form or characteristics, that are preserved or appropriate for preservation and used as an extension of human memory or to demonstrate accountability.

Archeological Sites

A location that contains the physical evidence of past human behavior that allows for its interpretation.

Natural Resources Definition

- Wildlife, fish, trees, and other biota
- Land
- Water
  - salt and fresh
  - surface or groundwater
  - used for drinking, irrigation, aquaculture, recreational purposes, and as fish and wildlife habitat

14
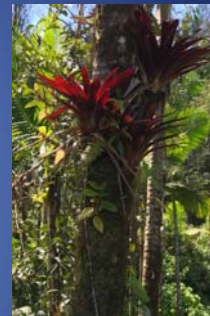
Wildlife & Fish & Habitat

15

Natural Resource Uses impacted

Recreation Sites

Boat Launches

Hiking, biking, and horse trails

Fishing/Hunting Areas

16

Efforts

DR-4339 NCR

Implementation Plans

Potential funding sources

COA Development

Assessments

Plan

Resources

Sustainability

Recovery

NATURAL AND CULTURAL RESOURCES SOLUTION TEAMS

Historic and Cultural Resources

- NCR1 Historic & Cultural Properties
- NCR2 Arts
- NCR3 Archives Mitigation and Modernization
- NCR4 Preservation, Research and Safe Storage
- NCR29 Museums

Coastal Systems Recovery

- NCR15 Corals and Seagrass
- NCR16 Wetlands
- NCR17 Beaches/Dunes
- NCR18 San Juan MPA

Landfills

- NCR8 Increase Capacity
- NCR9 Landfill Repair and Closure
- NCR10 Illegal Dumps
- NCR11 Sustainable SWMP

Natural Resources

NCR5 Forest Recovery
- NCR12 Forest Products Industry
- NCR6 At-Risk Species Recovery
- NCR7 Partner Networks for Species
- NCR13 Sediment Pollution/Landslides
- NCR14 Water Quality
- NCR21 Land Management Approaches
- NCR23 Alternative Tourism
- NCR20 Parks

Incident Occurs → **Impacts Assessed by Sector(s)** →

Solution Based Team
- PR
- RSF Lead
- FEMA Sector Lead & Staff
- Other Federal Agencies
- Private Sector
- Industry Experts & Academics
- Sectors with Interdependencies

→ **Unified Solutions Identified**

→ **Best Resources Identified & Applied**

OUTCOME/END STATE
- Public/private partnership
- A new, more resilient system benefitting and serving all residents of Puerto Rico
- New system allows for forward movement in future development

10

What can Solution Teams Do?

- Identify solutions to COAs
- Provide advice, recommendations and expertise to the Commonwealth
- Provide Commonwealth assistance in prioritizing projects
- Determine/suggest most appropriate sources of funding
- Provide technical assistance in scoping projects

Funding Recovery

Public Assistance Alternative Procedures (Section 428)

Guide for Permanent Work
FEMA-4339-DR-PR

April 2018
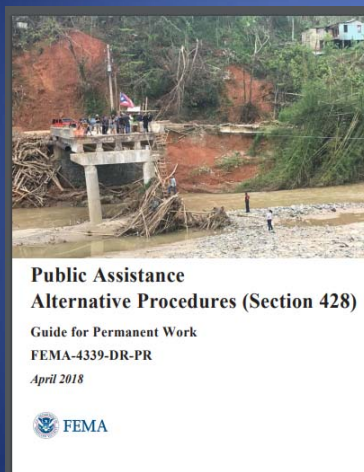
FEMA

FEMA 428 Public Assistance

FEMA 406 Hazard Mitigation

404 Hazard Mitigation (SHMO)

HUD CDBG-DR

Other Federal Agency – Supplemental

Federal Agency – Grants

NGOs

Philanthropic

Lessons?

Archives & Collections

- Issue: Motion Picture Vault (MPV) follow-up from 11/18 assessment, several other requests for assistance
- Team of four (three NARA, one Smithsonian; two with film expertise)
- Activity: Assessed MPV, Luis Munoz Marin collection, ICP building plans, ICP Archives object vault and Artes Plasticas objects
- Lesson: Scope of potentially impacted resources difficult to determine initially

PHOTOS COURTESY OF PRESTON HUFF, NARA

Hardwoods

- Issue: Several piles of woody debris in 16 different municipalities that need to be disposed of properly
- Lesson: In tropical areas downed wood IS NOT necessarily debris
- Activity: Assessment of valuable woods in piles. USDA (IITF, FPL) (March 12-22, 2019)

Corals

- Issue: Will coral reef restoration be considered eligible for PA?
- No decision yet, but questions re: constructed changes to corals
- Lesson: Application of PAPPG for non-traditional natural features is complex

PHOTOS COURTESY OF NOAA

Questions?

Response Challenges for Severe Weather or Tsunamis

Emergency Support Function #10 Oil and Hazardous Materials Response

✓ Provide EPA personnel to the FEMA RRCC and NRCC, JFOs, the EPA REOC, PR and VI EOCs and other coordination venues to support FEMA response operations in PR and the USVI.

✓ Removal, cleanup and disposal of oil & hazmat; collect and disposal of HHW; monitor immediate threats to public H&S and the environment in both PR and VI.

✓ Coordinate/Execute all necessary assessments, evaluations, sampling and analytical services/support to ensure the safety and quality of drinking water & wastewater systems in PR.

✓ Conduct Drinking Water Sampling Across the USVI.

✓ Repair of Ambient Air Monitoring Stations in PR.

✓ Provide Emergency Power to Non-PRASA Systems in PR.

Challenges / Lessons Learned

✓ Difficulties/delays in transporting personnel and equipment into PR and VI via flights and barges.

✓ Spanish speaking personnel.

✓ Equipment being held up in the VI ports due to demands for tax payments.

✓ Administrative hurdles from FEMA in efforts to make non-PRASA systems eligible for temporary repairs and emergency power.

✓ All hazardous materials needed to be transported to the mainland.

✓ Contracting issues associated with the procurement of ambient air monitoring equipment for PR.

✓ Use of DOI's iPac system to conduct Endangered Species Act Section 7 consultations for HHW staging areas worked well.

U.S. Environmental Protection Agency

Puerto Rico Branches

U.S. Environmental Protection Agency

Strategies for Collection

Collection Pads

3

4
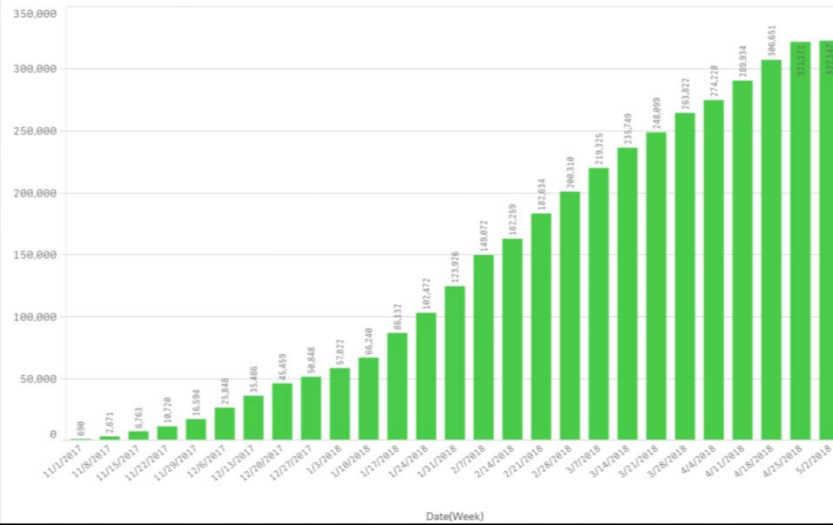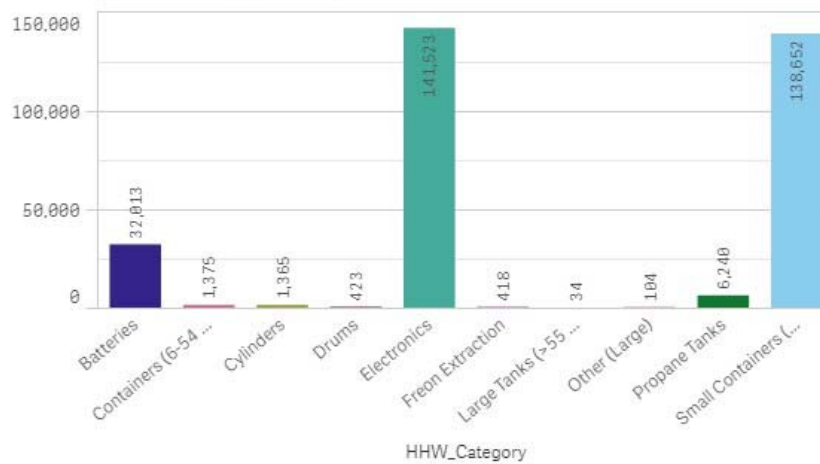
Contacts

U.S. Environmental Protection Agency, Region II

Caribbean Environmental Protection Division (CEPD)

City View Plaza II, 48 Carr. 165 Suite 7000

Guaynabo, PR, 00968-8073

- Carlos Huertas, On-Scene Coordinator
       Office: 787-977-5861

Lessons learned from Hurricanes Irma and Maria:

FEMA NCR RSF (2017-2019)

Ernesto L. Díaz

NRPT 2019 · San Juan, PR

Overview *…and first lessons learned!*

- Hurricanes Irma and María (Sep 2017) …*Not prepared for Cat 4 or 5!*
- Major Disaster declaration and response under FEMA ESF10-Request for Mission Assignments:
-RRF Sunken vessels removal (USCG)
-RRF Coastal, Nearshore and Beach Debris Removal (USACE)
- DNER requests FEMA Natural and Cultural Resources Sector to conduct
  Damage Assessments and support to develop COA for Coral Reefs, Seagrasses, Beaches, Dunes and Wetlands.
- DNER requests: Corals as eligible facility for Public Assistance:
  Critical Maintained Natural Infrastructure (Our Ask and the Evidence)

PR-CCC.ORG | @prclimatechange

1

Puerto Rico's coastal uses and assets

ECONOMICS

GDP: $105 billion/year (PRPB2016)
Tourism $2B/year
Built up Areas/Coastline 24%
Industrial Parks (81)
Commercial/Recreational Fisheries

Coastal population: **2.3 million (61%)** at **44** coastal municipalities

Territorial waters: **9 nm**   (A=5,078.9 mi²)

Coastline: **799 mi / 1,225 beaches (60% moderate to severe erosion)**

HOUSING

Public Housing (15)
Individual Housing (xx)

PUBLIC BUILDINGS

PNPs, Public Buildings not under other sectors

TRANSPORTATION

Airports (11)
Ports (12)
Bridges, Culverts, Piers
Miles of Primary Roads (17,387mi/27,982km

NATURAL AND CULTURAL RESOURCES

Protected Areas (Land) DRNA 8.7% (2015) – CLCC 16% (2016)
Protected Areas (Marine) 27.2%
Shallow coral reefs and associated communities designated for protection 49%
Historical Properties (22+)

3

Puerto Rico's coastal uses and assets

HEALTH AND SOCIAL SERVICES

Hospitals (3)
Treatment Centers (xx)

Coastal population: **2.3 million (61%)** at **44** coastal municipalities

Territorial waters: **9 nm**   (A=5,078.9 mi²)

Coastline: **799 mi / 1,225 beaches (60% moderate to severe erosion)**

COMMUNICATIONS

Fiber Optic Cables (15)
Internet Infrastructure
Public comms systems

ENERGY

Power plant systems (7; 5 public, 2 private)
Substations
Distribution and transmission lines

WATER

PRASA infrastructure at coastal zone: 200km potable water
260km sanitary infrastructure
6 water systems
Pump stations
Waste Water Treatment Plants (28 coastal)

EDUCATION

Schools (36)
PNP (xx)

4

...be ready to provide detailed maps of built up areas and natural assets!

Hurricane Irma 06 SEP 2017

Hurricane María 20 SEP 2017
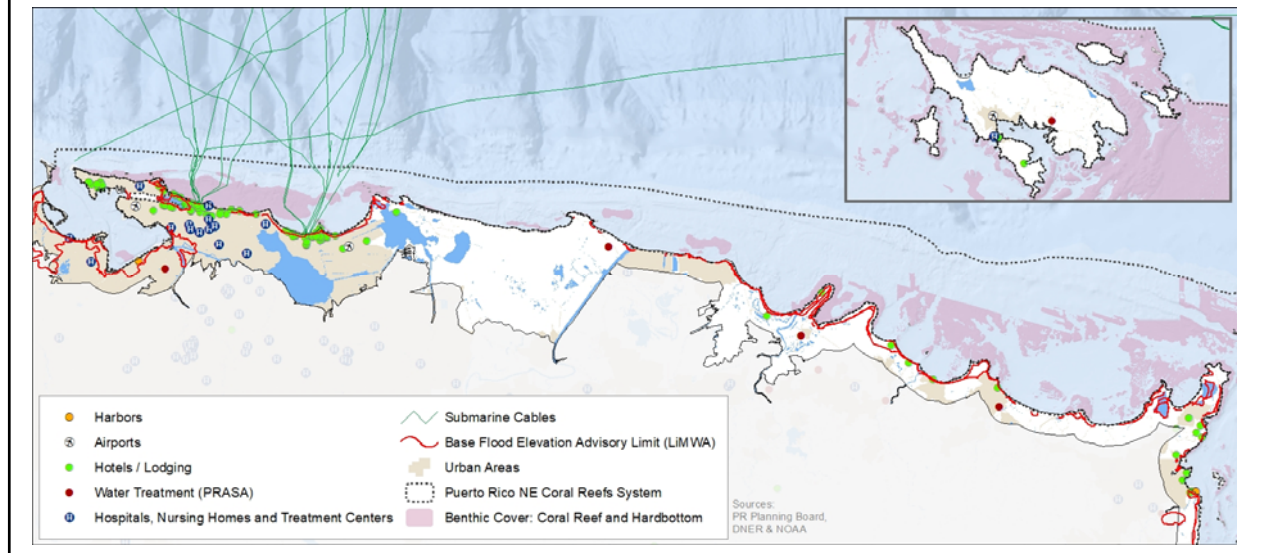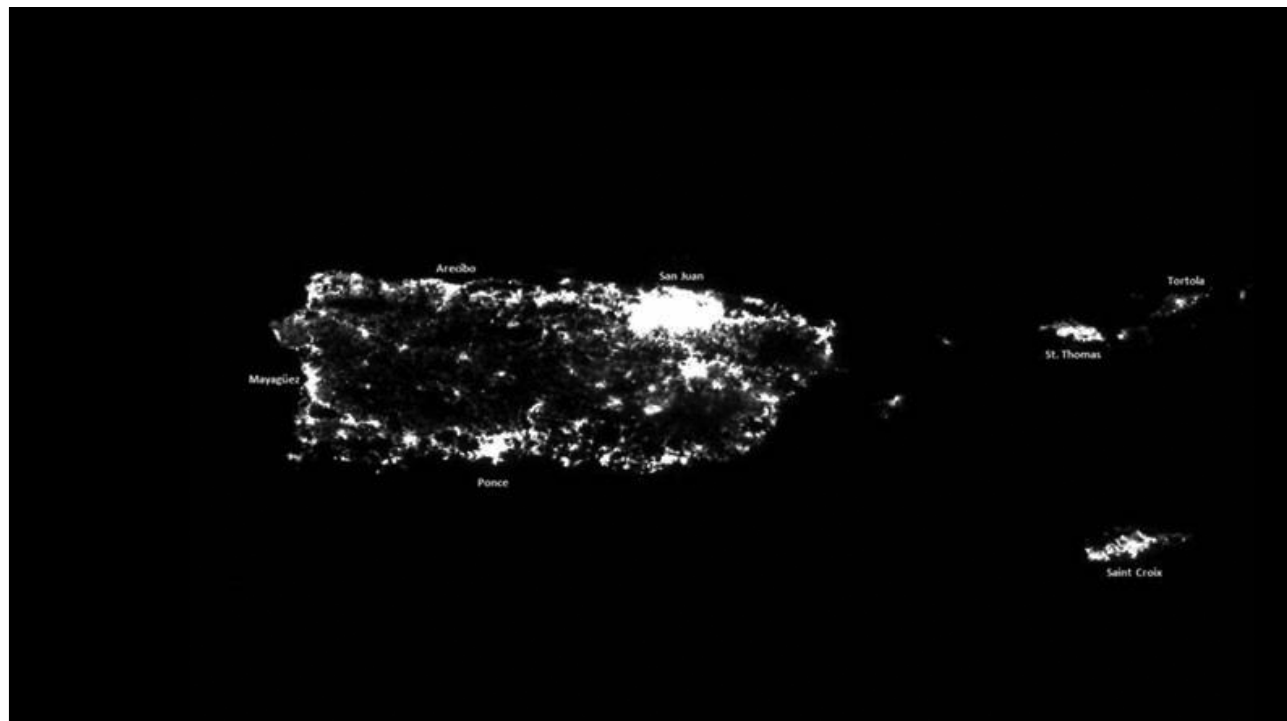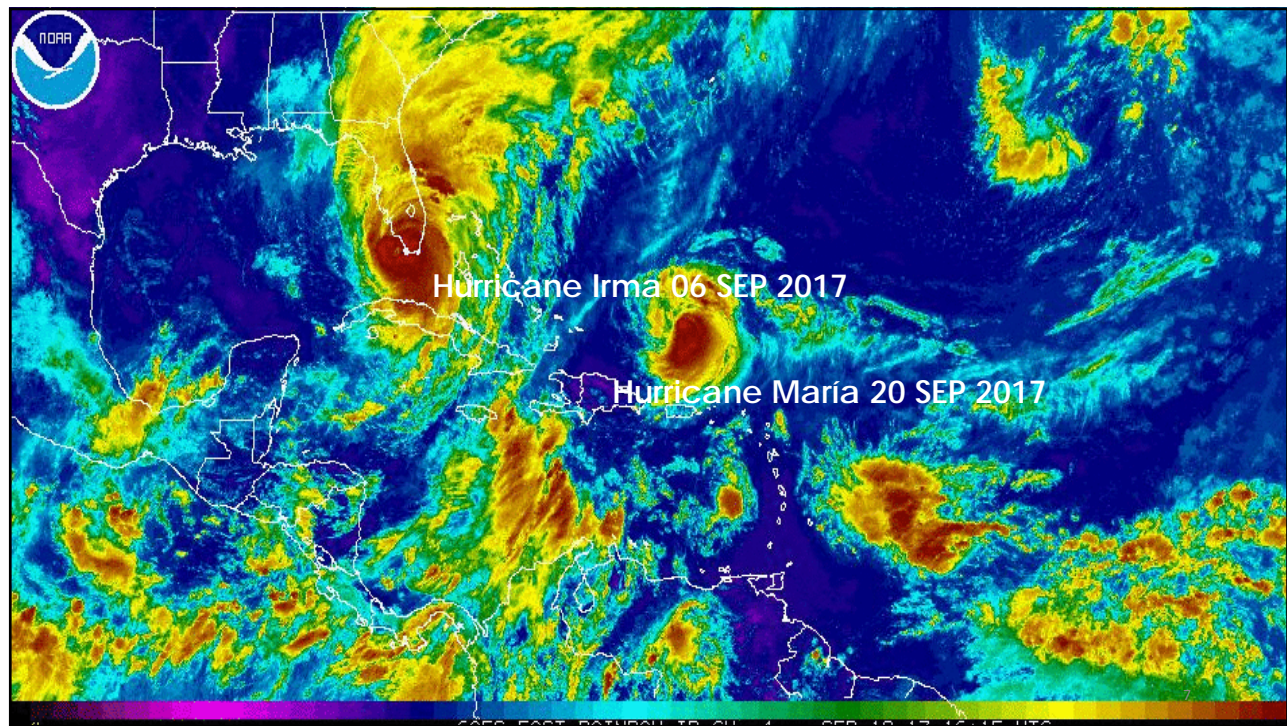
Coral Reef as Critical Maintained Natural Infrastructure

PRESENTED TO FEMA PA (2018)

10

FEMA requests: System Definition and Investments Documentation

>220 papers on coral reefs wave attenuation reviewed

SCIENCE ADVANCES | RESEARCH ARTICLE

ENVIRONMENTAL STUDIES

Coral reef structural complexity provides important coastal protection from waves under rising sea levels

Daniel L. Harris,[1,2,3*] Alessio Rovere,[1,2,4] Elisa Casella,[2] Hannah Power,[5] Remy Canavesio,[6] Antoine Collin,[7,8] Andrew Pomeroy,[9,10,11] Jody M. Webster,[12] Valeriano Parravicini[6]

Coral reefs are diverse ecosystems that support millions of people worldwide by providing coastal protection from waves. Climate change and human impacts are leading to degraded coral reefs and to rising sea levels, posing concerns for the protection of tropical coastal regions in the near future. We use a wave dissipation model calibrated with empirical wave data to calculate the future increase of back-reef wave height. We show that, in the near future, the structural complexity of coral reefs is more important than sea-level rise in determining the coastal protection provided by coral reefs from average waves. We also show that a significant increase in average wave heights could occur at present sea level if there is sustained degradation of benthic structural complexity. Our results highlight that maintaining the structural complexity of coral reefs is key to ensure coastal protection on tropical coastlines in the future.

Healthy Coral Reef

A healthy reef crests near the surface and serves as a major natural break-water—reducing most wave energy and helping protect coastal communities. Healthy reefs have abundant living corals, and support fishing industries and diving.

In coastal areas where wave energy is lower, mangroves can grow and further stabilize shorelines, reduce erosion, and provide nursery habitat for fish, shrimp and crabs.

Swiss Re

Designing a new type of insurance to protect the coral reefs, economies and the planet

A new type of insurance to protect coral reefs has been announced at the 2018 World Ocean Summit in Mexico. Swiss Re is proud to have supported the design of this new product which will not only help the conservation and swift restoration of the reef, if damaged by a major hurricane, but it will also support the economic resilience of the region and offers an opportunity to create a scalable new market for the insurance

San Juan metro coral reef system

Maximum simulated significant wave height (Hs, ft) for Hurricane María

15
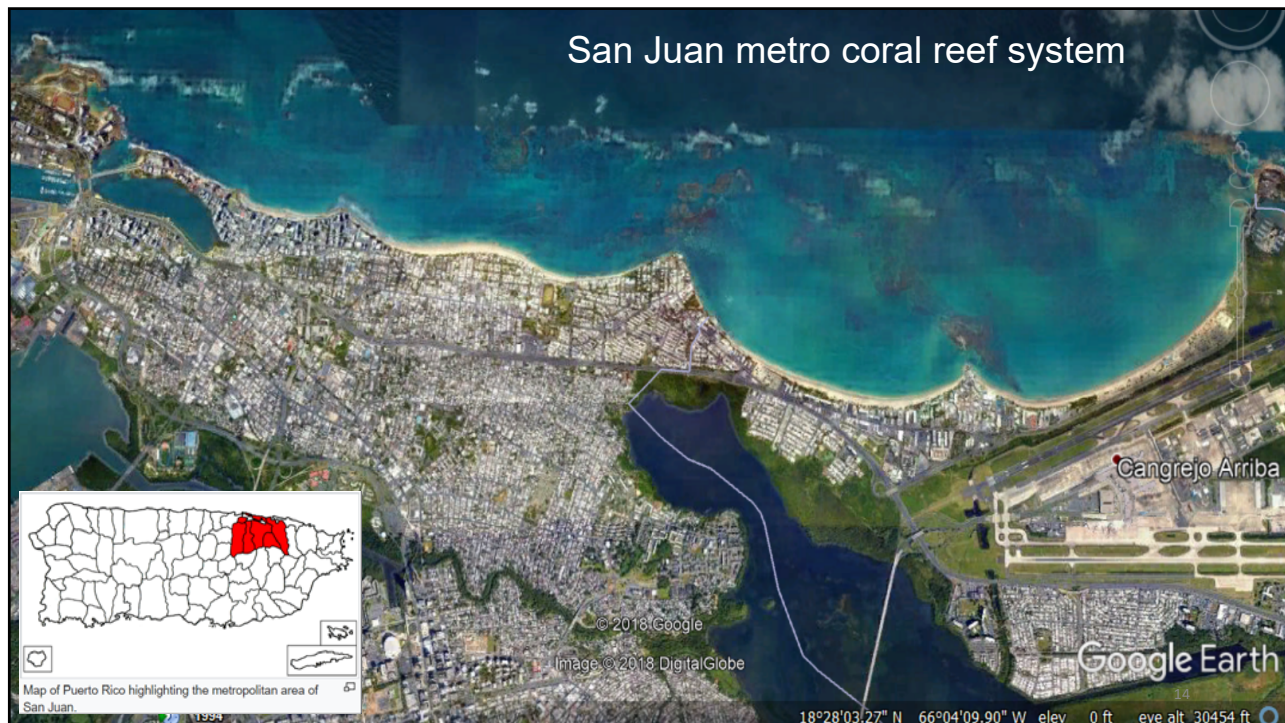
FEMA requests: Investment Documentation

DNER/FEMA Coral Reef Systems

Data repository for sharing

Coral Reef Maintenance Takes Many Forms
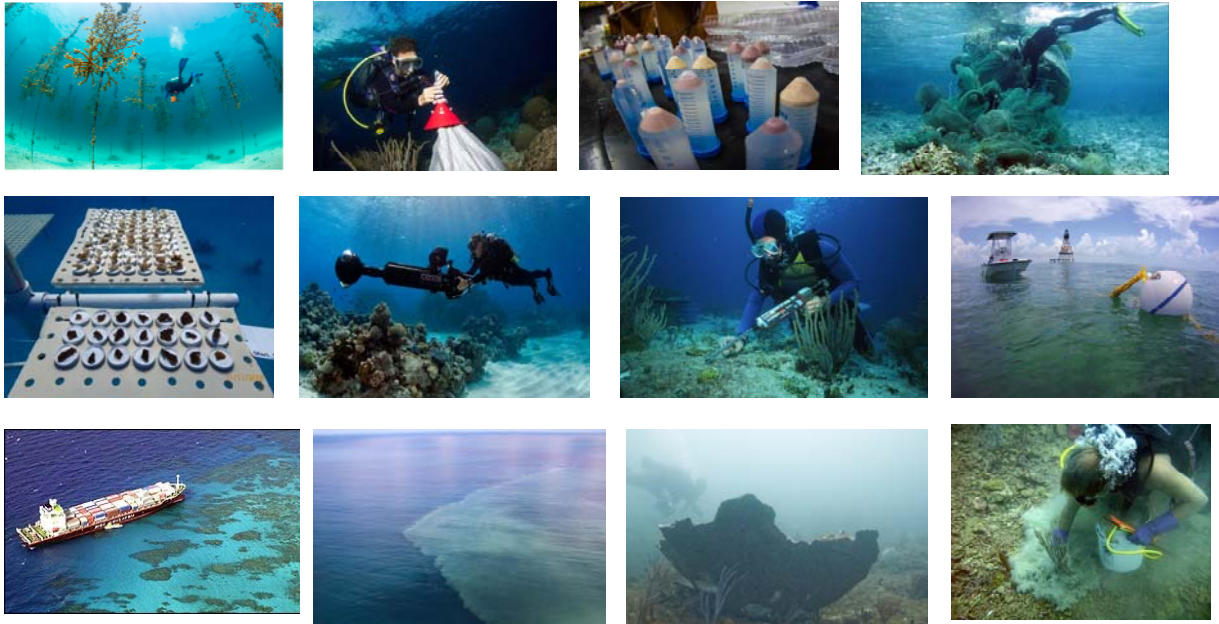
PR Coral System Investments: Collaborators

More detailed provided in the Spreadsheet

9

Investments estimates

Pie chart legend:
- Assessments, Response and Restoration
- Maintenance and Monitoring
- Improvement and Maintenance

$17,664,034 — 30%
$27,255,572 — 47%
$13,574,201 — 23%
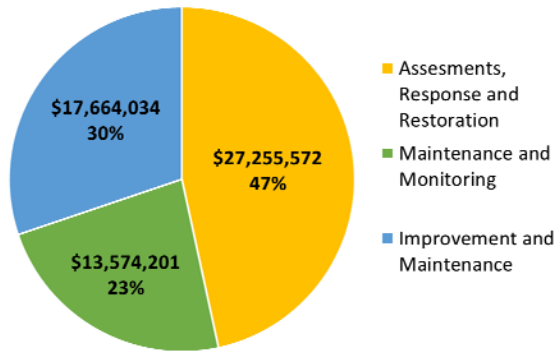
$58,493,807

of investments in the Northeast Coral Reef System during the last 30 years

19

Eligible Facility

Applicant – DNER ✓

Facility Is it the legal responsibility of an eligible applicant? ✓

Is it located in a designated disaster area? ✓

Is it not under the specific authority of another Federal agency? ✓

Was it in active use at the time of the disaster? ✓

Was it damaged as the result of the declared disaster or emergency? ✓

Is it a designed and constructed improvement? ✓

Does the constructed improvement enhances function? ✓

Does the applicant maintain the improvement? ✓

COST
WORK
FACILITY
APPLICANT

20

Eligible Facility

Work Is work required as a result of the declared event? ✔
Is the work within the designated disaster area? ✔
Was the work the legal responsibility of the applicant at the time of the disaster? ✔
Does it fit into a FEMA category of work [Permanent work – Category G] ✔

Cost Is it reasonable and necessary to accomplish the eligible work? ✔
Does it comply with Federal, State, local and tribal requirements for procurement? ✔
Can the costs be reduced by all applicable credits, such as anticipated insurance proceeds and
salvage values? ✔

COST
WORK
FACILITY
APPLICANT

21

FEMA   **Policy Advisory**

Title: Coral Reef facility eligibility

Keywords: Coral Reef, facility, eligibility, planting, beach,

Project Description: Coral Reef Restoration

Requestor: Puerto Rico Department of Natural and Environmental Resources (DNER)
Sector: NCR
Subrecipient: Puerto Rico DNER
Project Category: G
Project Size: $

Policy Issue or Question: Is the restoration of a coral reef by the Puerto Rico DNER eligible for
Public Assistance?

22

Lessons learned:

- Must prepare for the next one.

- Build back and retrofit stronger and resilient.

- Corals and natural infrastructure must also be restored to protect coastal communities, critical infrastructure and biodiversity.

Puerto Rico Emergency Management Bureau

Carlos A. Acevedo Caballero
Commissioner

PREMA - Mission

Coordinate all the resources of the government and the private sector, to provide the fastest and most effective services before, during and after emergency situations to ensure the protection of life and property of citizens.

Hurricane Maria – September 20th, 2017

- Was a category 4 hurricane and could be reclassified to category 5.
- $ 3,919,899,824.36 - Total Public Assistance Grants
- $ 1,226,870.001.79- Total in Individuals and Household Program
- 463,752 applications approved for the Individual Assistance Program
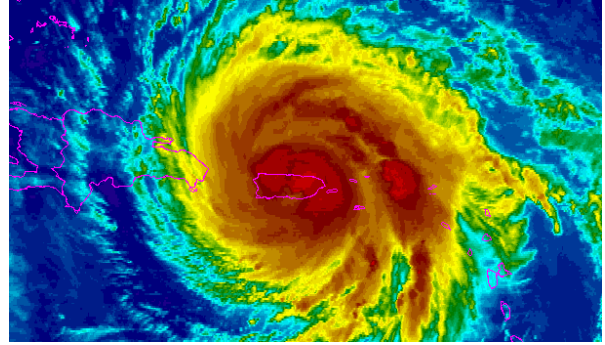
Foto: NOAA

Municipalities of Puerto Rico

- The **78** municipalities of Puerto Rico were designated under the Public Assistance and Individual Assistance Programs.

Hurricane Maria

- More than 70,000 houses lost their roofs.
- Total collapse of essential services.
- 64 direct deaths caused by the hurricane.
- 2,975 deaths related to the hurricane, according to a study conducted by the University of George Washington
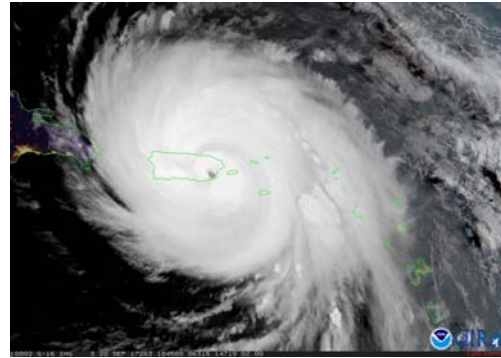
Foto: NOAA

PREPA

Foto: El Nuevo Diario

PRASA

Foto: Telemundo

Communications

Fotos: NMEAD

Flood

Comerío

Toa Baja

Foto: Facebook

Guajataca Dam

Structural Damages

Aibonito

Foto: NMEAD

Foto: El Nuevo Día

Structural Damages

Adjuntas

Utuado

Foto: Facebook

Foto: FEMA

Commodities Distribution

Maricao

Fotos: NMEAD

Changes in Emergency Operational Plans

Changes in Emergency Operational Plans

- The Emergency Operational Plans of the government agencies and municipalities were worked from scratch to bring them to a catastrophic level and temper them to the reality faced after the passage of Hurricane Maria.

- Before the passage of the phenomenon by Puerto Rico, the plans were prepared for the scenario of a category one hurricane (1).

- Uniform systems of plans, training and exercises are developed.

- The state and municipal emergency management structure is strengthened.

Warehouses

Warehouses

- Important changes were made to the Supply Distribution Plan to ensure that citizens receive them fast, safely and orderly.

- As part of these efforts, in conjunction with the Department of Housing, over 20,000 cots were distributed to be located in the shelters of the municipalities.

- One of the priorities of the Bureau has been to deliver supplies to the 78 municipalities so that, in the event of an emergency or disaster, they can meet the needs of citizens.

Warehouses

- Historically, Puerto Rico has depended on the supplies provided by FEMA that have warehouses located on the Island.

- To meet the need of Puerto Rico, the Bureau acquired two warehouses, located in Guaynabo and Ponce where water and food supplies are maintained, as well as emergency response equipment and basic necessities.

- The Bureau is preparing to locate more warehouses.

Communications
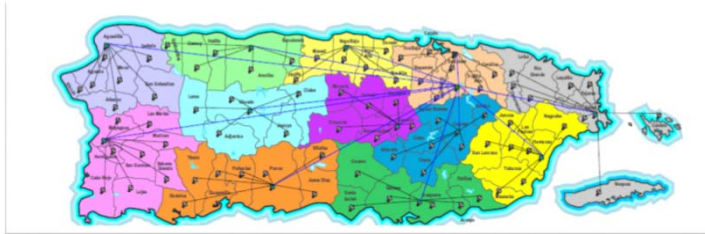
Communications

- In order to guarantee communication between the response agencies during emergencies, we are installing satellite communication systems in all Police Commanders, Fire Stations, Ambulance Dispatches, Emergency Management Bureau regions, as well as the Emergency Operations Centers (COE) of the 78 municipalities.

- In addition, radios of 100 watts are being installed in the facilities, as well as in more than 300 hospital institutions around the Island.

- These radios go from one antenna to another, without the need for a repeater, which ensures a better response and communication in case of a collapse.

Alliance with the Private Sector

Alliance with the Private Sector

- For the first time, representatives of private companies have a space in the Emergency Operations Center (COE), to work together with the government and respond to the needs of citizens.

- Among the sectors that are present in the COE are: manufacturing, food, hospitals, telecommunications, broadcasters, media, infrastructure, transportation and gasoline.

Questions or Comments

Tsunami Mission and Products

NOAA NRPT LEARNING FROM THE PAST AND MOVING FORWARD: RESPONSE CHALLENGES FROM SEVERE WEATHER OR TSUNAMIS TO SHARED TRUST RESOURCES AND MISSION RESPONSIBILITIES

San Juan, PR

April 23-25, 2019

Christa von Hillebrandt-Andrade

NOAA NWS Caribbean Tsunami Warning Program

Japan 2011
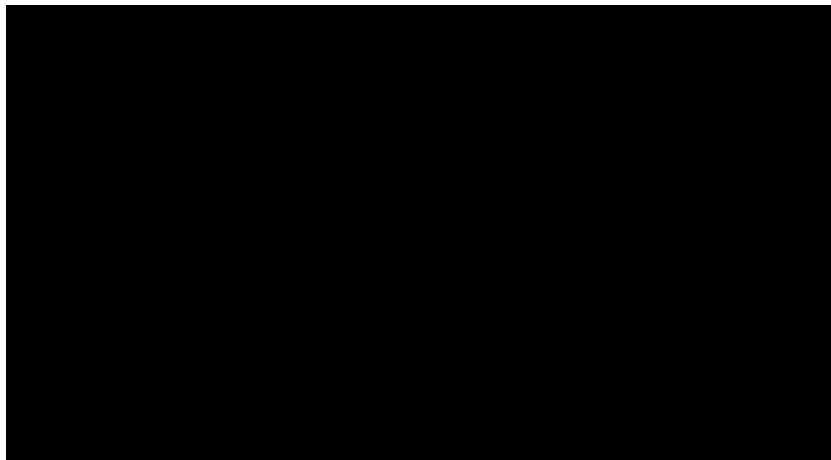
Tsunami Warning Information

Natural Tsunami Warnings
- Strong coastal earthquake shaking
- Rapid sea level changes
- Roaring sound

Official Information
- Federal, State, Local govt
- Important for distant tsunamis

Informal Information
- Friends, neighbors, relatives
- Media, SMS, social networks…

3-3

Strong Earthquake

2010, Crescent City, USA

ACTION
Drop, Cover, and Hold.
Go Inland to High Ground Immediately.

DO NOT WAIT FOR OFFICIAL EVACUATION ORDERS

3-4

Noticeable Rise or Fall of Coastal Waters

1946, Hilo, USA

1995, Mexico

ACTION
Go Inland to High Ground Immediately

DO NOT WAIT FOR OFFICIAL EVACUATION ORDERS

3-5

For Official Information:
Tsunami Warning Centers

- TWCs are reliable and dependable; 24x7

- Monitor seismicity for large earthquakes

- Monitor sea levels for tsunamis

- When alarms trigger, evaluate earthquake for tsunami threat

- Issue official tsunami threat messages to authorities and public

3-6

Pacific Tsunami Warning Center (PTWC)

NOAA Inouye Regional Center, Ford Island, Pearl Harbor, Hawaii

Operations Center PTWC

PTWC Services PR, USVI and BVI and with international messages the rest of the Caribbean

Director: Dr. Chip McCreery

TWC Communication Pathways

- TWC messages are:
  - authoritative, coordinated among other TWCs
  - issued simultaneously to many customers (international, national, local, private sector, public)
  - reliable since they are working 24x7
  - redundant since they are issued through many communication pathways
  - broadcast because of time urgency

3-8

U.S. Tsunami Warning System Communications Diagram

Métodos de comunicación
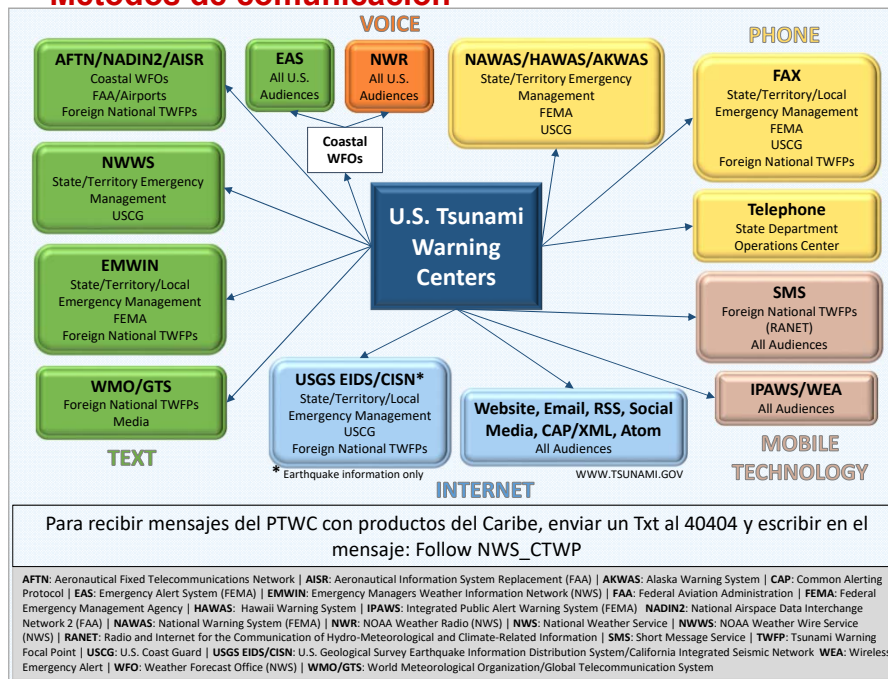
US Tsunami Alert Levels

Tsunami Messages: Alert Levels

	WARNING	ADVISORY
TWC Alert Level:	WARNING	ADVISORY
TWC-determined Threat:	EXPECTED FLOODING	STRONG CURRENTS LIKELY
Local Authority Safety Action:	EVACUATION RECOMMENDED	STAY AWAY FROM SHORE

3-10

Tsunami Messages: Alert Levels

TWC Alert Level:	**WATCH**	**INFORMATION STATEMENT**
	↓	↓
TWC-determined Threat:	**DANGER LEVEL NOT KNOWN**	**NONE or MINOR WAVES AT MOST**
	↓	↓
Local Authority Safety Action:	**PREPARE, STAY ALERT FOR MORE INFORMATION**	**NO ACTION SUGGESTED**

3-11

Tsunami travel time contours at 15-minute intervals across the Caribbean region to the island of Puerto Rico. The white contours are labelled in hours of travel time. Red dots show the location of historical earthquakes having depths less than 100 km. They primarily outline boundaries between tectonic plates in the Caribbean region.

Ejemplos de productos de los TWC: Terremoto en PR/VI o el Caribe, Peligro Potencial de Tsunami

Transcurrido	Producto	Descripción
00:00	Terremoto	Ocurre terremoto local, Mw ≥ 7.1
00:03	Observatory Message*	Parámetros del terremoto preliminares y revisados por PTWC – Activa entrada en el CISN
00:04	Aviso PRVI	Aviso de Tsunami para PRVI basado en los criterios iniciales
00:25	Aviso, Advertencia o cancelación PRVI	Pronóstico de tsunami basado en el mecanismo del terremoto y la data de nivel del mar. Mantiene, actualiza o degrada el nivel apropiado de Alerta o genera una cancelación.

* Usado principalmente por instituciones sismologicas y entidades tecnicas (RSPR, CTWP)

Transcurrido	Producto	Descripción
00:55	Aviso, Advertencia o Cancelación PRVI	Mensaje complementario con lecturas de nivel del mar de mareógrafos costeros cercanos o DARTS. Cambio en nivel de alerta es posible basado en las lecturas.
01:25	Aviso, Advertencia o Cancelación PRVI	Mensaje complementario con lecturas del nivel del mar de mareógrafos cercanos costeros o DARTS Cambio en nivel de alerta es posible basado en las lecturas.
01:45	TWC Anuncio llamada de conferencia	Mensaje a PREMA, VITEMA, BVIDDM, WFOSJ, y PRSN anunciando llamada de conferencia.
02:00	TWC Llamada de conferencia	Llamada de conferencia del TWC con PREMA, VITEMA, BVIDDM, WFOSJ, y PRSN para discutir situación.
03:00+	Aviso, Advertencia o Cancelación PRVI	Cada media hora hasta que la alerta disminuya o se cancele.

NOAA/NWS Pacific Tsunami Warning Center Users' Guide Tsunami Warning Products for Puerto Rico, U.S. Virgin Islands and British Virgin Islands

- Product Description
- Timeline for issuance of products
- Product Identifiers and Dissemination
- Example of Products

Caribewave.info

Cancellation versus All-Clear

- Cancellation Message issued by TWCs
  - Officially cancels warning, watch, and advisory messages
  - Means that destructive waves have stopped
  - Does not mean it is safe to return to Tsunami Hazard Zone
- Official All-Clear issued by local authority when it is safe to re-enter the Tsunami Hazard Zone

3-15

Warning Process: How it Reaches the "last mile" on the coast

- Emergency Alert System: Radio and Television
- NOAA Weather Radio
- Sirens

3-17

Wireless Emergency Alerts

- Current: Tsunami danger on the coast. Go to high ground or move inland. Listen to local news. –NWS
- Proposed (English/Spanish):

    NWS: Tsunami danger on the coast. Move to high ground or inland now.

    SNM: Peligro de tsunami. Vaya a un lugar alto o tierra adentro ahora.

- Proposed (Longer Message English/Spanish)

    The National Weather Service has issued a tsunami warning. A series of powerful waves and strong currents may impact coasts near you. You are in danger. Get away from coastal waters. Move to high ground or inland now. Keep away from the coast until local officials say it is safe to return. Check local media for more information after you are safe.

    El Servicio Nacional de Meteorología ha emitido un aviso de tsunami. Olas y corrientes fuertes pueden afectar costas cercanas. Está en peligro. Aléjese de aguas costeras. Muévase ahora a un lugar alto o tierra adentro. Manténgase alejado hasta que las autoridades locales indiquen que es seguro regresar. Verifique información oficial una vez esté seguro.

Tsunami.Gov – one stop for official tsunami products (national and international)

How People Get Warnings: Assumption

- Official Information
- Information flow is linear from one source

3-18

How People Get Warnings: Reality

- Official & Informal (Unofficial) Information
- From many sources at same time
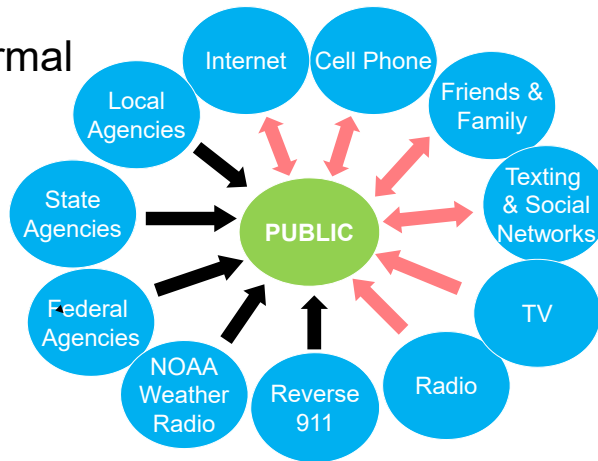
3-19

Need to Test the System: CARIBE WAVE

PARTICIPATION ON CARIBE WAVE EXERCISE PER YEAR

Year	Participation
2013	44,000
2014	191,000
2015	191,420
2016	332,812
2017	679,985
2018	643,403
2019	792,289
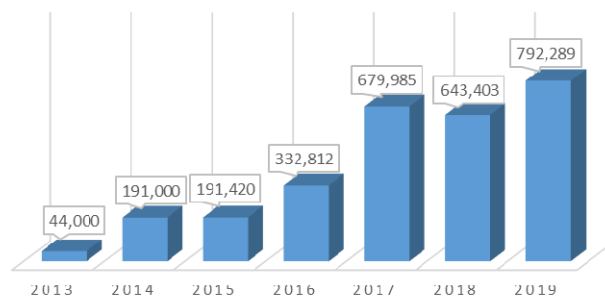
Summary

- Described types of tsunami warning information
- Described how Tsunami Warning Centers work
- Described types of tsunami messages
- Described the warning process and how it reaches "the last mile on the coast"
- Emphasized importance of communication testing

3-22

Products and Forecast
for
Decision Makers

Ernesto L. Morales
Warning Coordination Meteorologist
NOAA/NWS Weather Forecast Office San Juan
Ernesto.Morales@noaa.gov

NOAA/NWS MISSION

- **Provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy.**

WFO San Juan and NHC

- **Same Mission but with a different scope**
- **NHC** **focus on the forecast of the intensity and trajectory of the tropical cyclone.**
- **WFO SJU** **focus on the impacts in our local forecast area based on the NHC forecast.**
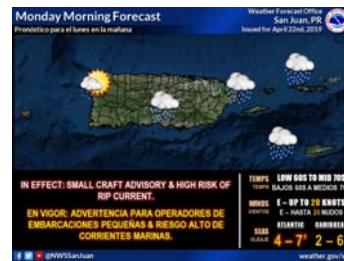
WFO Knowledge of Potential Peak Impacts
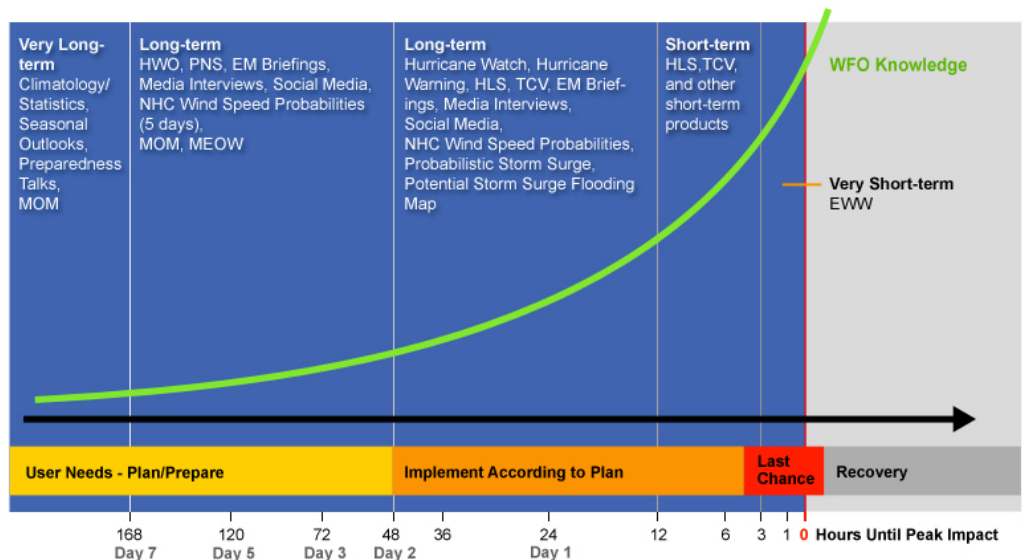
NWS/NOAA

Very Long-Term

- **Seasonal Outlooks**
- **Climatology/Statistic**
- **Preparedness talks**
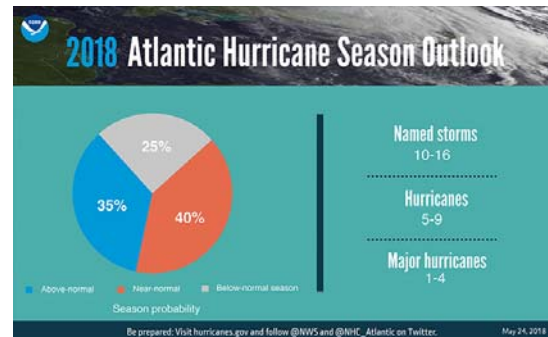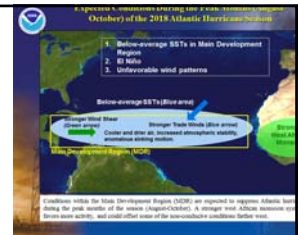
Tropical Cyclone Climatology
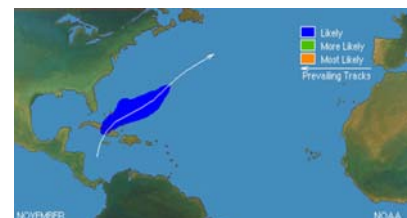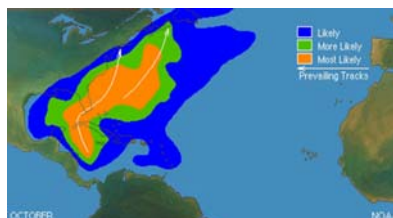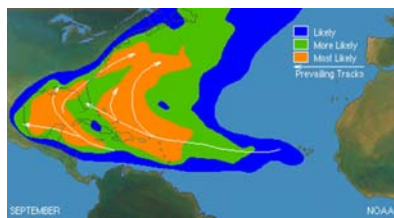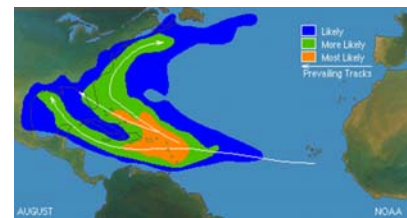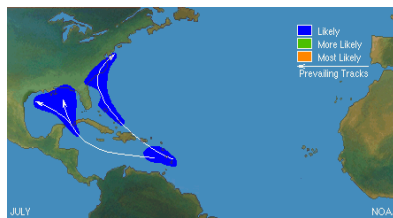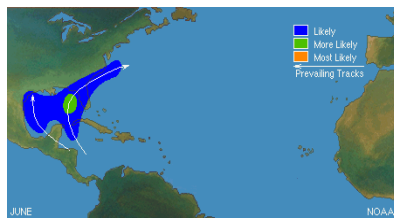
Long-Term (day7-day2)

- **Hazardous Weather Outlook**
- **Emergency Management briefings**
- **Media Interviews**
- **Social Media**
- **Graphicast**
- **NHC Tropical Weather Outlooks ***

*Issued by NHC

5-Day Graphical Tropical Weather Outlook
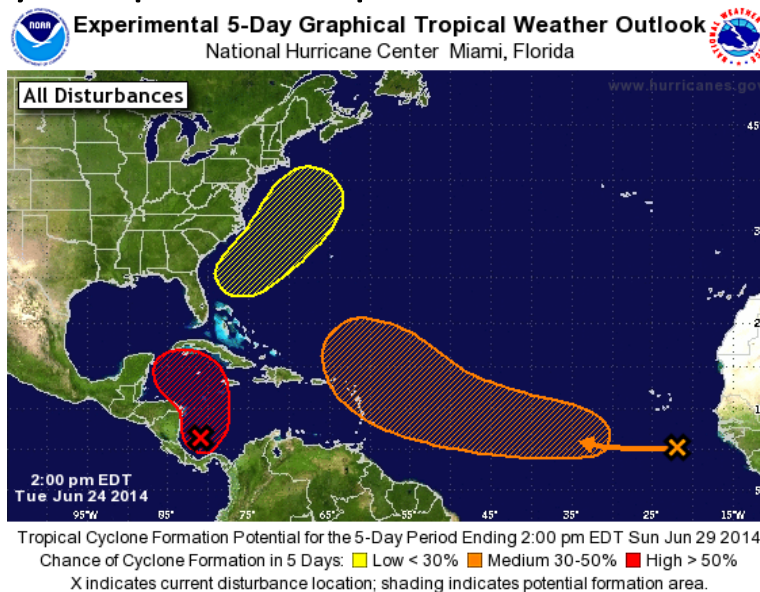
Two-Day Graphical Tropical Weather Outlook
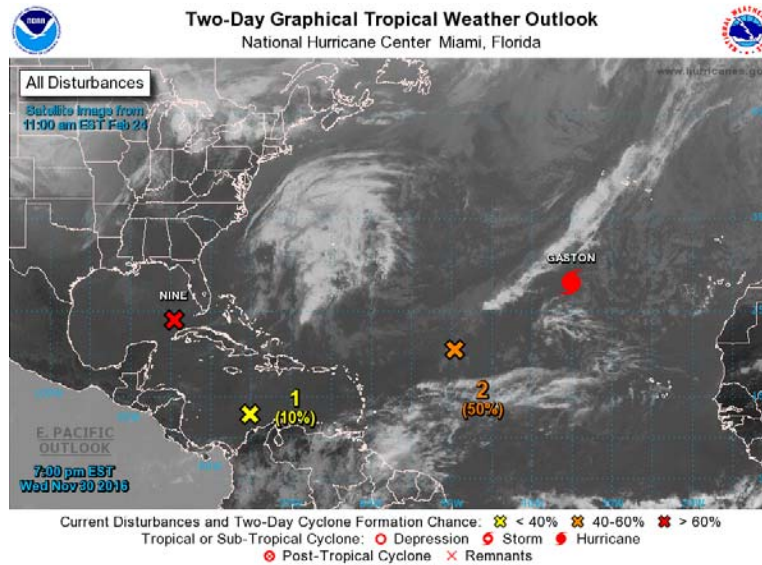
Hazardous Weather Outlook

Weather.gov/sju

Graphicast

Long-Term (day2-12hr)

- **Hurricane Local Statement**
- **TCV**
- **Emergency Management briefings**
- **Media interviews**
- **Social Media**
- **Track Forecast Cone***
- **Hurricane Watch***
- **Hurricane Warning***
- **NHC Wind speed probabilities***

NHC Track Forecast Cone

www.nhc.noaa.gov
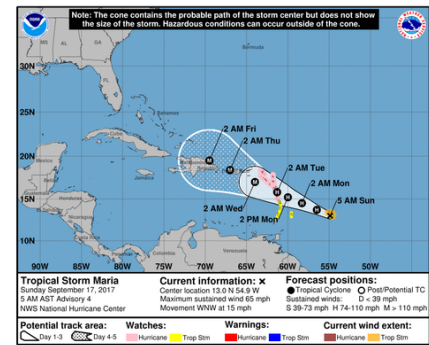
Old NHC Forecast Cone
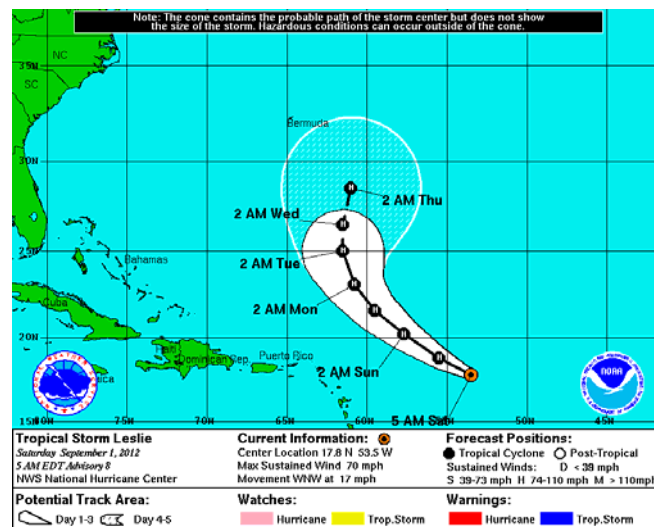
New NHC Forecast Cone Product

Most Likely Arrival Time of Tropical-Storm-Force Winds

Hurricane Maria
Sun. Sep. 17, 2017 5 pm AST
Advisory 6
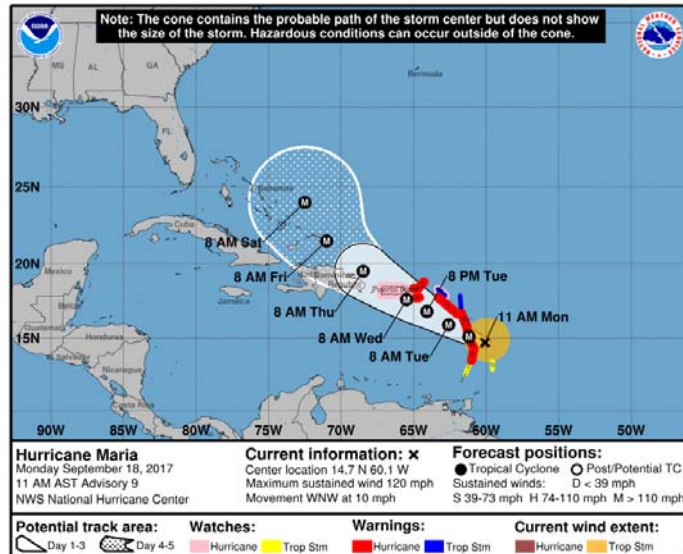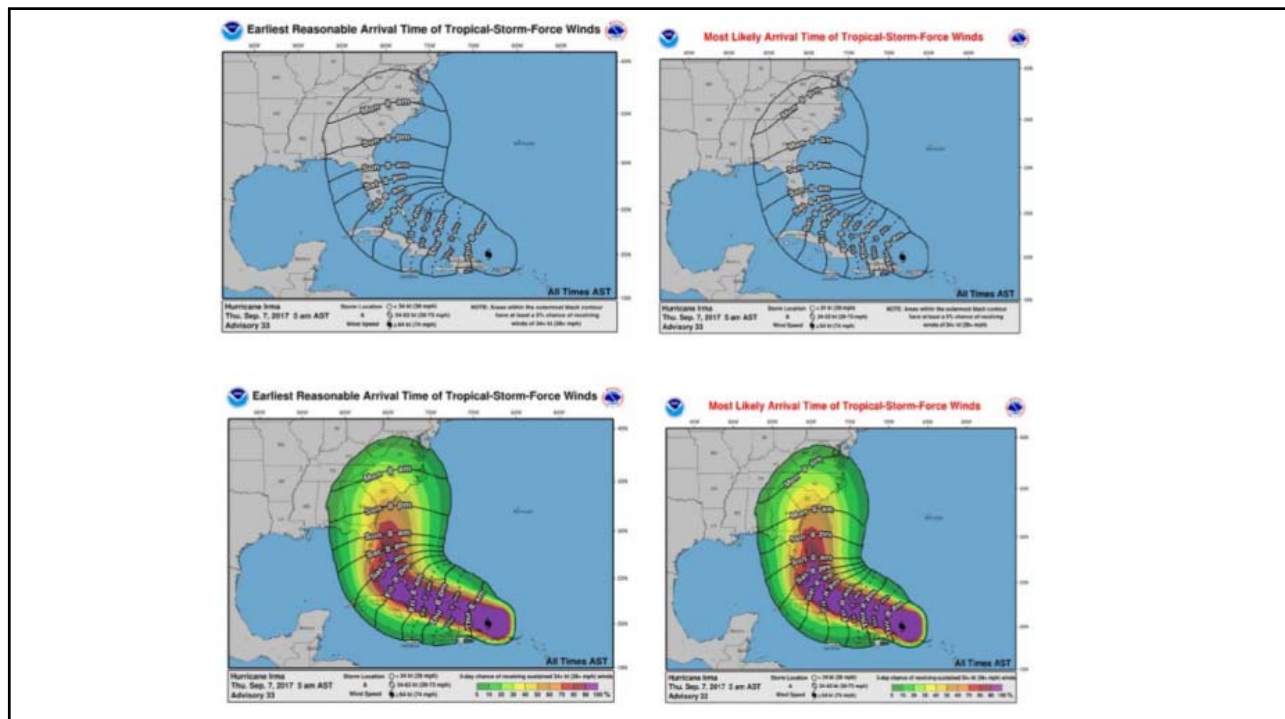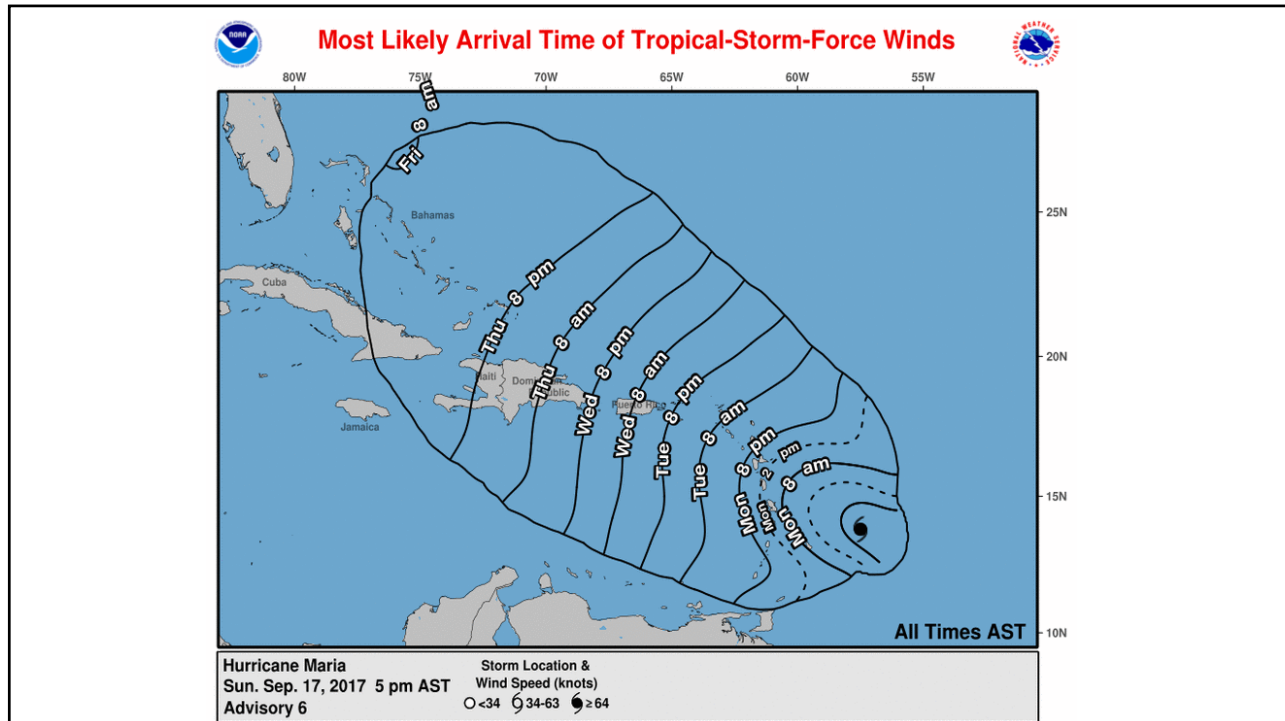
Short-Term (12hr-3hr)

- **Hurricane Local Statements**
- **Tropical Cyclone VTEC (TCV)**
- **Other short term products**
  - **Stand Alone Products**

Very Short-Term

- **Emergency Flash Flooding**
- **Extreme Wind Warning**

Emergency Flash Flooding

Extreme Wind Warning

- **Winds associated to the center of the cyclone.**
- **Hurricane Category 3 or more.**
- **Sustained winds of 115mph or higher.**

Recovery
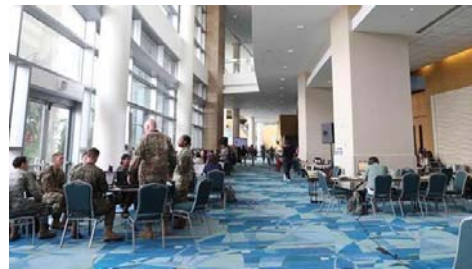
Follow the Official Source of Weather Information

National Weather Service SAN JUAN PR

(787) 253-4501 or (787)253-0615

www.weather.gov/sju

Twitter: @NWSSanJuan

www.facebook.com/

www.nhc.noaa.gov

www.weather.gov/sju   US.NationalWeatherService.SanJuan.gov   @NWSSanJuan

Puerto Rico Emergency Management Bureau

CHALLENGES FROM SEVERE WEATHER OR TSUNAMIS
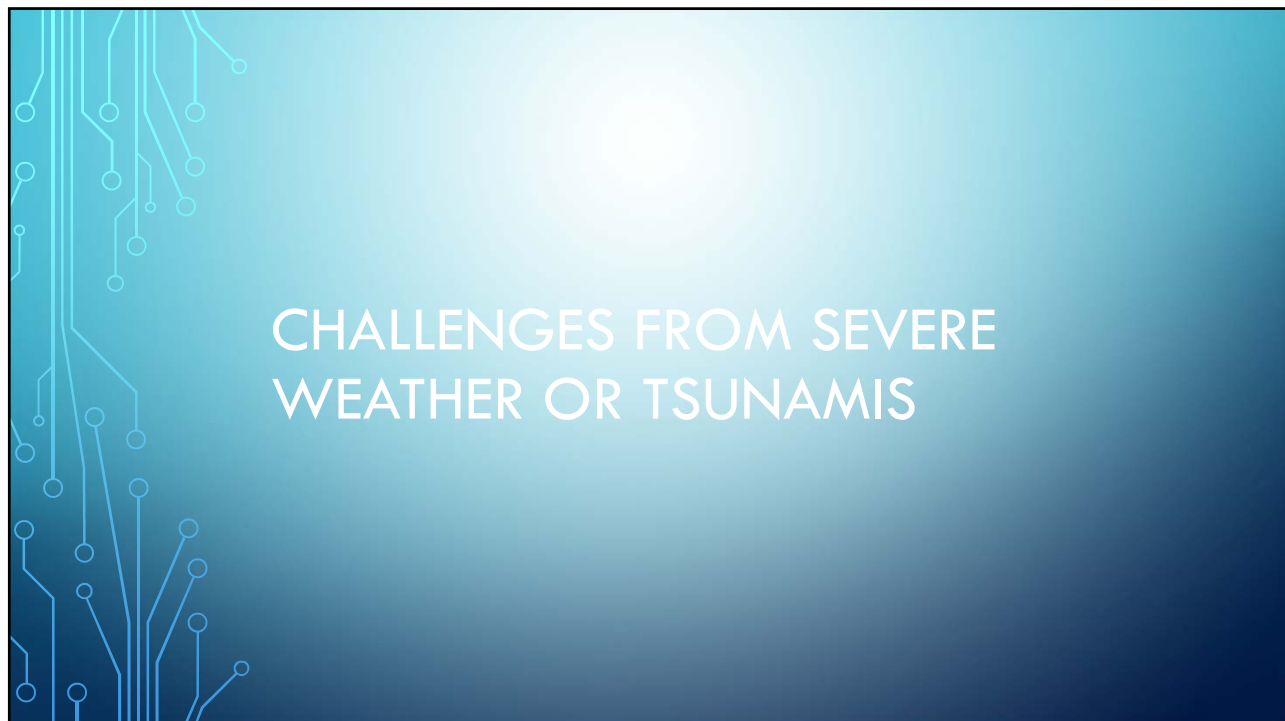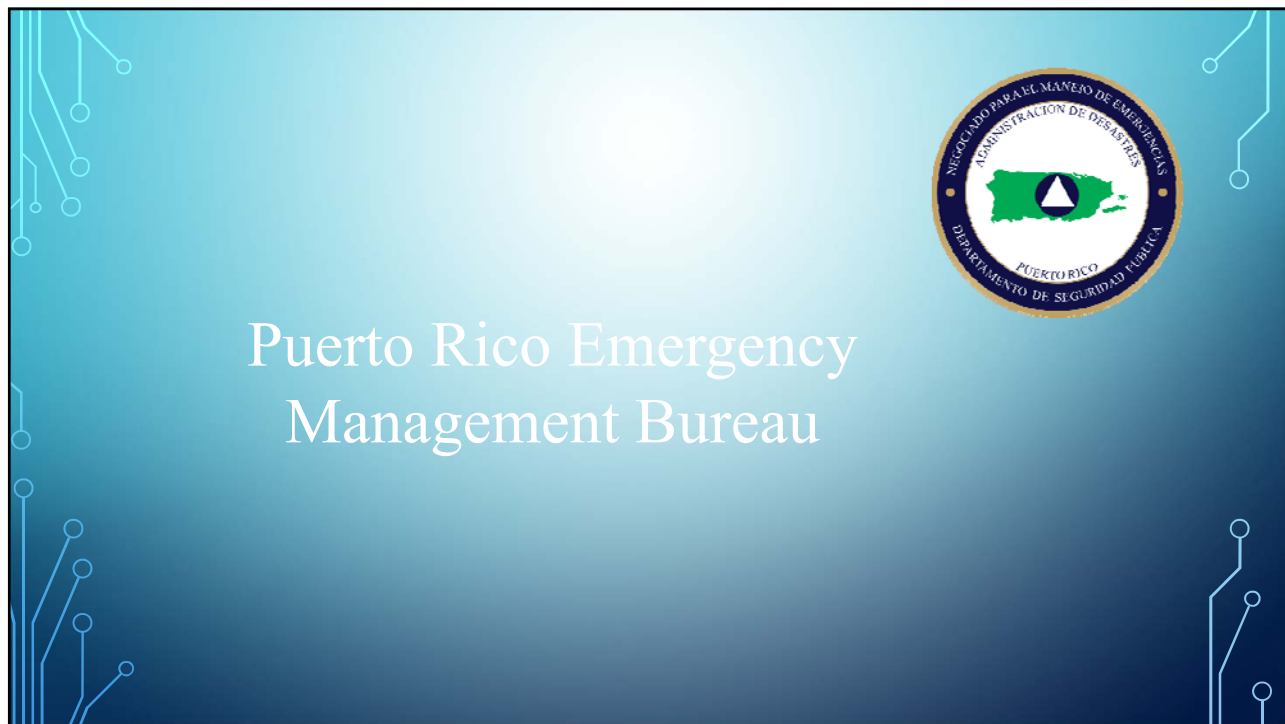
RISK COMUNICATION

LEARNING FROM THE PAST – IMPROVEMENTS FOR THE FUTURE

Severe weather

Severe weather

Hurricane

Hurricane

Earthquake
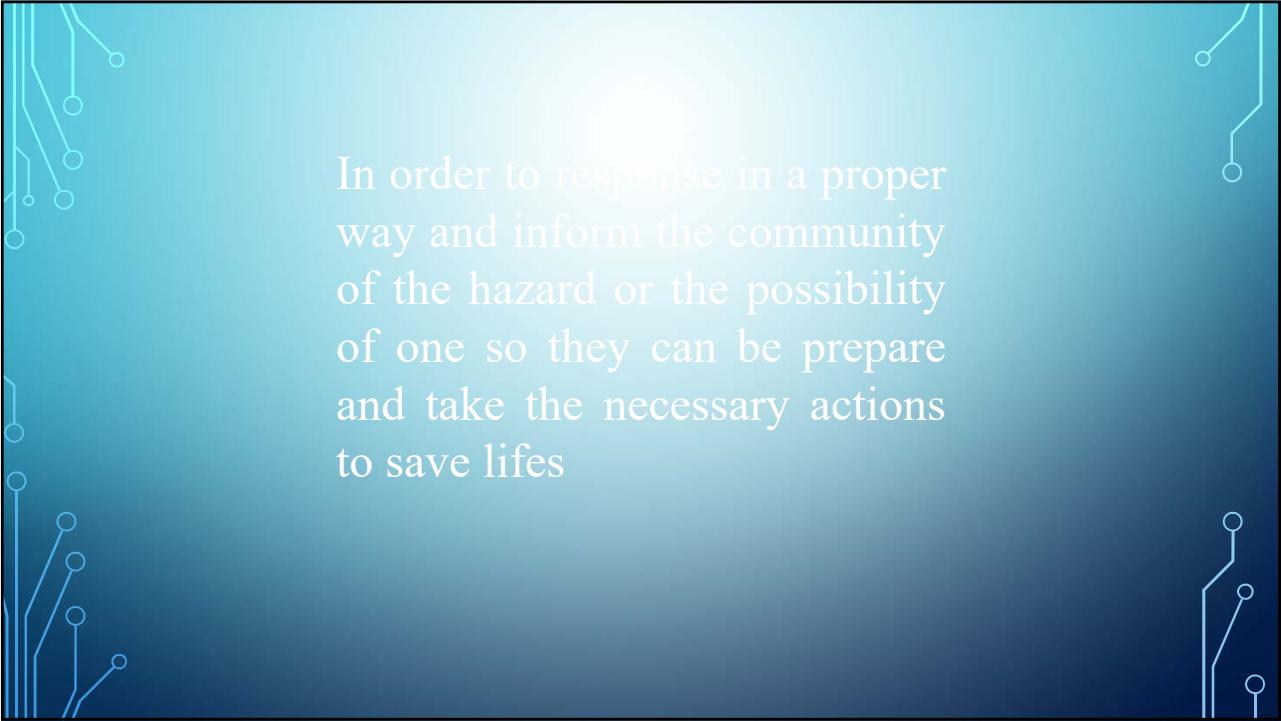
Earthquake

Tsunamis
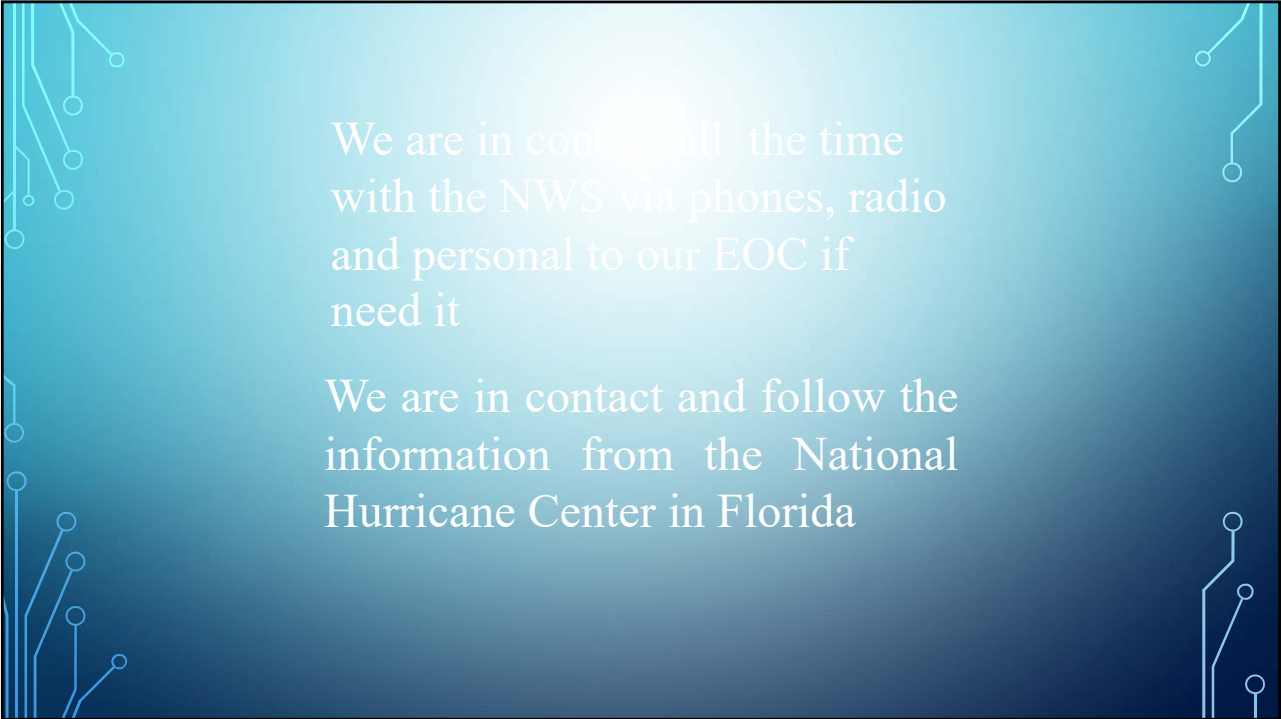
In order to response in a proper way and inform the community of the hazard or the possibility of one so they can be prepare and take the necessary actions to save lifes

We use different official sources and elements to collet information and to get it to the public as fast as we can and necessary
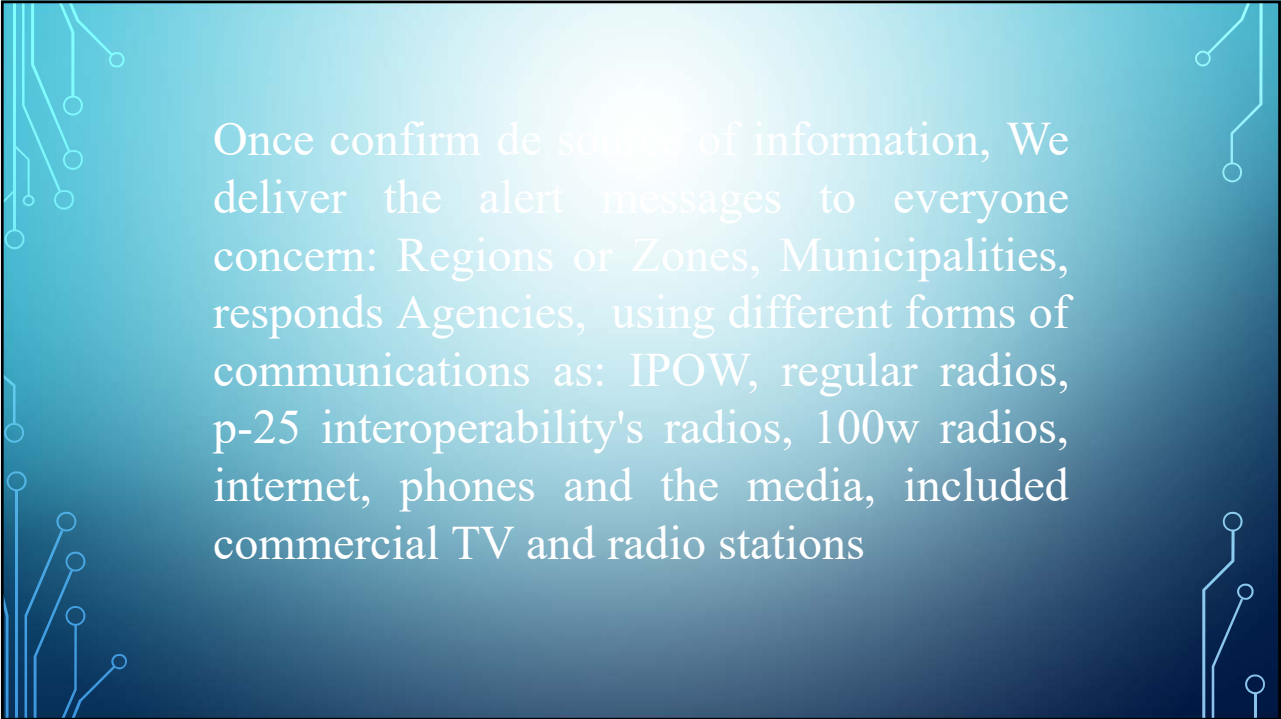
We are in contact all the time with the NWS via phones, radio and personal to our EOC if need it

We are in contact and follow the information from the National Hurricane Center in Florida
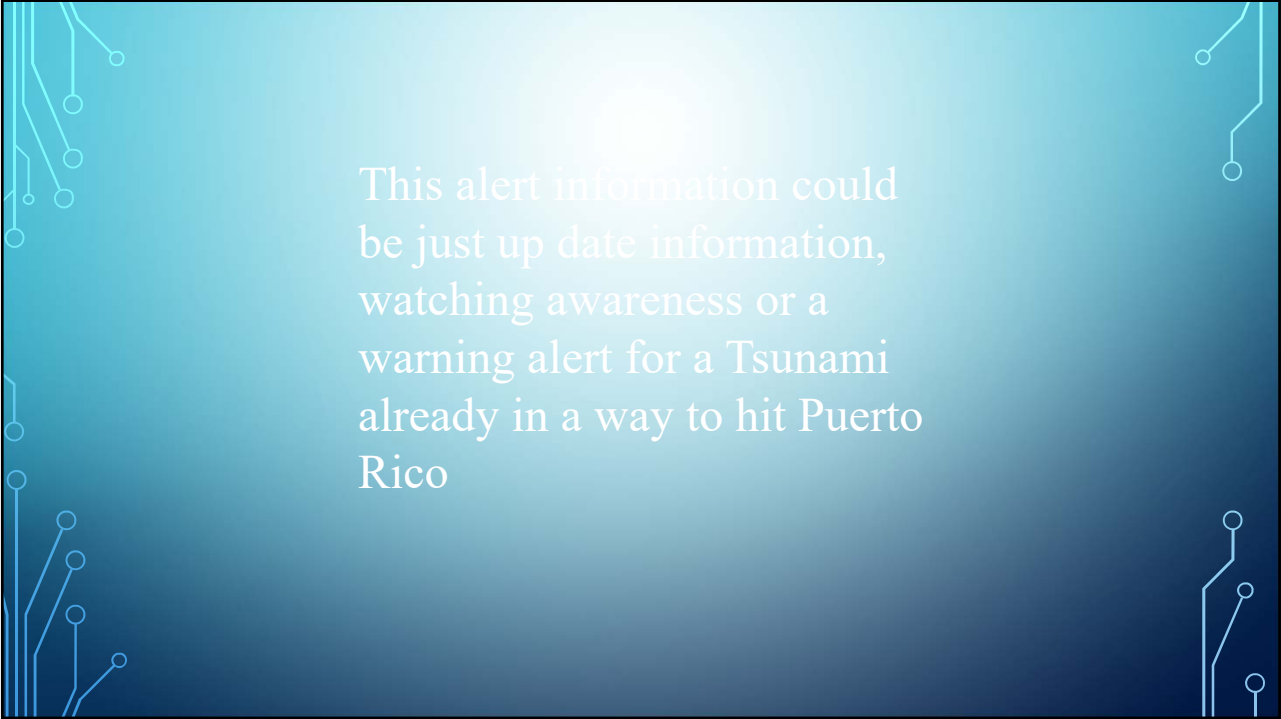
We recive information from the PTWS, PRSN and the NTWC, also the NWS

We use the ENWIN System, internet systems, Ring down systems, faxs and phones systems

Once confirm de source of information, We deliver the alert messages to everyone concern: Regions or Zones, Municipalities, responds Agencies, using different forms of communications as: IPOW, regular radios, p-25 interoperability's radios, 100w radios, internet, phones and the media, included commercial TV and radio stations

This alert information could be just up date information, watching awareness or a warning alert for a Tsunami already in a way to hit Puerto Rico

At the same time we will active the State EOC and all the components of every EFS to give the support need it at the field

Basically the key and critical point handling this phenomes is the risk to loose the communication before, in the middle or after the emergency happened, so you can not give the coordination and help to the communities that you suppose to offer and they need

We must educate the communities, other responders, agencies, work together and be prepare and ready to anything and everything in order to accomplish our mission with the people of Puerto Rico

Any Question ?

Thank you

Appendix D: Workshop Breakout Group Notes

Appendix D: Breakout Session 1

Group A

Category	Identified Response Challenge	Lessons/Practices/ Skills Learned	Explanation/ Description	Timeframe Following Disaster	Safety of Staff/Staff Families	Cross Jurisdiction (federal, commonwealth, local)	Shared trust resources
Communication	Desensitizing of alarms	Take culture into account when designing communication	"Burn out"	Mission Response	Yes (depends on education)	ALL	ongoing education
	Not taking forecast seriously	Information needs to put everyone on same page (official source)	Too many unofficial sources of information	Mission Response	Yes (depends on education)	ALL	
	Sources of Information	Educate public to follow official source(s) of weather information	Government (NWS) vs Mass media & social media	Mission Response	Yes (depends on education)	ALL	
Resources	Lack of maintenance of resources	Needs to be prepared before event , need maintenance logs and funding necessary	Infrastructure, equipment, generators, machinery, hospitals, water treatment, dredging (Most dependent on funding)	Cascading delays across response/ recovery	Yes - everybody	ALL	Funding availability, education, budgeting, accountability

	Not enough resources	Cannot properly respond causing snowball effect, improvisation insufficient = must plan ahead, stockpiling supplies beforehand, Both access and distribution, *More efficient distribution system that is equitable, prior plans (&funding?) of impartial parties responsible for distribution of resources to communities (NGO, red cross, churches)	Priority on imported supplies, permission limits some provisions. Do not having enough resources, leading to less accessibility and distribution	Both response and post event	Yes, directly	ALL	planning, knowledge of resources (within agency and inter) and necessary MOU prior, awareness / transparency of resources
	Communication infrastructure	redundancy with options, total loss of communication can happen, ham radio can work	Similar to lack of maintenance, structures failed	Mission Response	Yes	ALL	reliance on other agency's structures
Preparation	Lack of plans for an event of this magnitude	Need to plan, practice, train for worst case scenarios		ALL (pre, during, post)	yes	ALL	

Leadership	Leadership	Empowering (training, organizing, informing) communities is crucial, developing volunteering structure (cultural shift) = in response to communities not relying on gov., training of leadership,	turnover of leadership, lack of organization, lack of commitment of employees	ALL (pre, during, post)	yes, indirectly	ALL	

Group B

Identified Response Challenge	Lessons/Practices/Skills Learned	Explanation/Description	Timeframe Following Disaster	Shared Trust Resources	Safety of Staff/Staff Families	Cross Jurisdiction (federal, commonwealth, local)
Response plans exist	But not ownership, accountability, disseminated, activated on	Plans existed, not updated, not used, systems not adequate, did not reflect current codes and standards	Mission Response		many plans affect staff/families	All
Land Use Plan	We must enforce sensible use of land use plan and zoning; assess on paper but in reality is different (i.e., zoning)	Building again in high-hazard area (i.e., schools, hospital, NWS)	Recovery Activities		yes - schools, sensitive public buildings	commonwealth and local

Communicate the severity danger/risk	Because of the size of the island, confidence in the forecast/warning; people get desensitized with many hurricanes missing Puerto Rico; so many warnings with nothing happening, people choose not to respond	Having public understand the risk; people think they are lucky, manage expectations, warning fatigue	Mission response and recovery activities; large timeframe	NOAA	yes	Yes - all
Simultaneous hazard events may require unknown flexibility	Need tabletop exercises that are more complex, multi-scenario, some scenarios require staff safety ahead of protocols, need redundancy	There is a plan for NWS for continuity, but has not been exercised	Mission Response	NOAA	yes	Yes - all
Capacity for multiple, simultaneous disasters	Climate change could lead to stressors to staff/resources/retention.	Competition for resources. Trained/experienced resources. Turnover of political/experienced/burnout staff		FEMA	no	federal and commonwealth
Marine/land debris hindered by lack of staging areas and logistics	Need pre-identified staging areas	See Florida plans for an example	Mission Response		no	All
Rapid assessments of damage/debris were critical	Areas that had quick assessments made it easier to scope federal funding		Mission Response		no	All
Don't restructure the organization during a disaster*	**Building a new type of structure during a disaster leads to added pressure, lack of**	**Sectors and grant manager introduced part way during a disaster created problems**		**FEMA**	**yes (mental health**	**federal but impacts all**

	experience, unclear goals				and field safety)	
Policy guidelines need to be revisited due to change and new technology, climate change etc.*	**Policies need to be revised before an incident**	**E.g., coral reef and green technologies**	**Timeframe: prior to disaster**	**FEMA; Staff PAPPG**	**no**	**federal**
Police evacuated people in danger zones when cell down	Pre-emergency coordination with municipal (door knocking, whats app) repeat weather messages	Build relationships prior, build trust, work together	Mission Response	All	yes	All
Deadlines need to be flexible, but…	FEMA extends deadlines. Are these good or bad? False expectations. Inefficient timeframe	Repairs and legislation				
Be broad and bold on initial assessments	Baseline for FEMA to consider funding opportunities (repair, restoration)	Puerto Rico initial RSF was broad and created opportunity for recovery	Both	All	no	All
Lack of pre-scripted mission assignments/Duplicity of efforts*	**The more pre-scripted mission assignments, the quicker response activities can commence and provides training opportunities within agencies**					

Other Federal Agencies (OFAs) need to be assertive in their supplemental funding request*	You snooze, you lose	There are some things FEMA cannot fund				
Community response efforts. Develop a community plan.	Community members segregating debris; reaching out to the elderly; local communities will engage if given the opportunity, they take ownership, sense of community (helping your neighbors)	Encourage self-sufficiency and help others. Opportunity to teach young people. Resiliency				

Bolding indicates priority items

Group C

Identified Response Challenge	Lessons/Practices/Skills Learned	Explanation/ Description	Timeframe Following Disaster	Shared Trust Resources	Safety of Staff/Staff Families	Cross Jurisdiction (federal, commonwealth, local)
Communications & interoperability between organizations/groups	Requires a compatible system	Hard to communicate between regions due to economic and technical barriers	Pre-disaster		Yes	All
Communication	Back to basics- simple solutions (e.g., radio, information runners)	Cannot assume standard communication infrastructur	During, Post-disaster		Yes	All

		e will be available in the event of a disaster- need a back- up plan				
Interpersonal- layers of bureaucracy slowed progress	Need to identify an authority- in past only identified problem	E.g., resource request form- wanted submitted online but had no internet access, politics getting in the way of progress	During			Commonwealth and local
High turnover rate of response positions	Need to maintain and document experiences, and put them into practice. Done through education and more trainings	Loss of knowledge and details slip through the cracks. Use authority (knowledge of who has it)	Pre-,Post- disaster			Commonwealth and local
Did not pre-emptively involve private sector	Involve private sector during contingency plans. Make the link on how to support municipalities/local organizations (e.g.,	Private sector often has resources it can contribute to response	all (pre, during, post)		Yes	All

	transportation/ gas/food)	effort- have resources and assets connected at all levels.				
Release of emergency supplies in ports	Circumvent barriers using emergency declaration to streamline that (e.g., turn off taxation during response.)	E.g., tax and revenue process/polit ical fix	During			All
Getting assets to people	Use multiple avenues to distribute resources (e.g., NGOs, faith based & private)	E.g., FEMA taking goods, hotels, etc. (entire supply chain)	During, Post-disaster			Commonwealth and local
Getting community to know and buy into existing procedures/framework s	Better communication of information & informing communities at the grass roots level	Get community to know emergency response framework and procedures. Guidance and mechanism in place. Socialize process and standardize, disseminate	all (pre, during, post)			Commonwealth and local

		to municipalities on how to follow framework				
Logistics	Pre-planning on how to get resources to the island, and distributing in reasonable amount of time	Prior contracts need to be in place before disaster, distribution networks need to be established	all (pre, during, post)			All

Group D

Identified Response Challenge	Lessons/Practices/Skills Learned	Explanation/Description	Timeframe Following Disaster	Shared Trust Resources	Safety of Staff/Staff Families	Cross Jurisdiction (federal, commonwealth, local)
Ability to communicate with small communities	Post emergency communication needs to be simple and tailored to community	Lacked proper terminology to inform community	Recovery Activities		Yes	Fed-->c.w.-->local
People inadequately prepared for category 4 or 5 hurricane	Should prepare regardless of category level	Prior close calls/hurricanes missing the island gave a false sense of security & resources were moved to VI to deal with Hurricane Irma	Preparation		Yes	All

Communities relying on social media and not official sources of information	More outreach about what official sources of information are	Lack of exposure to official sources, too much exposure to other information	Pre, During, Post		Yes	Local
Lack of emergency planning	Local level preparedness plan created with central point of information	Starting from family, community, local, regional	Preparation		Yes	All
Contingency planning for emergency communication	Need more than every-day, standard communication	E.g., radio, paper map, ham radio	Preparation		Yes	Commonwealth/local
Lack/enforcement of residential building codes	More damage and loss of life due to unsafe structures	Building codes not enforced, and people did not understand homes were unsafe	Preparation	Drinking water, protected resources	Yes	Commonwealth/local
Vulnerable population	Don't wait until hospital is impacted to make decisions/hospital need redundant or back up energy sources	Disabled/sick/elderly people were stuck in place	Preparation		yes	Maybe federal, definitely Commonwealth/local
Access to clean water	Ran out of water	There was no redundant water for residents/no cisterns	Preparation	drinking water, clean water	Yes	Commonwealth/local
Port accessibility limited because of law	Necessary aid could not be distributed/get to local communities quick enough	San Juan is major port for food/resources coming to PR. Other ports are used for petroleum products, coal, etc.	Pre, During, Post		yes	Commonwealth/local

Current infrastructure was/is not hurricane ready	Maintain/update infrastructure to withstand hurricanes	Roads, power lines, etc.	Preparation	infrastructure, power		Commonwealth/local

Appendix D – Breakout Session II

Group A

Challenge Category	Identified Response Challenge	Explanation/Description	Lessons Learned	Improvement(s) (Actionable Tasks)	How does approach change with respect to Tsunami vs Hurricane?	Comments
Communication	*Communication with small communities*	Lacked proper terminology to inform community	Post emergency communication needs to be simple and tailored to community	Map communities & identify liaisons, focus groups to identify effective language/terminology, science communication training for personnel in agencies 1. Database of community needs based on geography, demographics, resiliency center possibilities, existing infrastructure 2.Establishing community liaisons	Island wide for both (Pre emergency), evacuation communication, inland vs coastal impacts different (Post)	

		Lack of exposure for official sources, too much exposure for other information	More outreach about what official sources of information are	Local gov support of NWS, teach resource quality, scientists create "internet image", before season: sit down with forecast communicators, consider certifications, spend time with communities to ensure understanding of maps / skills at community level to ID official sources. 1. create official emergency website/social media and promote/market it as a user friendly resource (2) link back to authoritative sources NWS	No	TV personalities vs NWS (creation of controversy for views), NWS is less entertaining and has to follow protocols vs beliefs
	Communities relying on social media and not official sources of information					
	Communication of the severity danger/potential risk	Having public understand the risk; people think they are lucky, manage expectations, warning fatigue. "Burn out"- desensitizing of alarms	Because of the size of the island, confidence in the forecast/warning; people get desensitized with many hurricanes missing Puerto Rico; so many warnings with nothing happening, people choose not to respond. Take culture	"remember Maria", continuous outreach to remind (e.g. poster), probability concept, Message: "You control your risk" by reducing your vulnerability	more desensitization with Tsunamis because of infrequency	

			into account when designing communication lines			
Infrastructure	*Lack of access to clean water*	No redundant water for residents/no cisterns	Ran out of water	Promote/fix policy for rainwater capture, investigate/ revise rainwater capture policy (resiliency center example), community workshops on virus protection fitting into cultural norms (list of best practices). 1. Reduce barriers to home/commercial rainwater capturing 2. encourage rainwater collection/capture with safe treatment		
	Poorly maintained infrastructure	E.g., failure of infrastructure (water); waiting for gov. to maintain infrastructure	Empowering communities to take accountability/r esponsibility of infrastructure	Enforce construction code, certified inspectors, education for empowerment in maintenance solidarity training. 1. Informal contractor training 2. use best construction/maintenance practices from other hurricane/ prone states and countries	coastal vs island wide (different types but similar problem)	benefit for local may have regional impacts

Leadership	*High turnover within leadership position and trained personnel; limited capacity for multiple, simultaneous disasters*	Competition for resources. Trained/experienced resources. Turnover of political/experienced/burnout staff. Don't restructure the organization during a disaster	Climate change could lead to stressors to staff/resources/retention. Need local level leaders-educated through trainings. Minimize turnover.	Professionalize emergency management positions, establish/increase emergency management schools, Local level leader training. 1. develop curriculum from vocational schools to higher learning institutions	No change	
Logistics	*Port accessibility is limited during response because of existing laws*	San Juan is major port for food/resources coming to PR. Other ports are used for petroleum products, coal.	Necessary aid could not be distributed/get to local communities quick enough. Circumvent barriers using emergency declaration to streamline that (e.g., turn off taxation during response.)	Laws impeding maritime supplies should be temporarily waived (Jones Act) for appropriate timeframe (or permanently). 1. neutral study on PR relevant Jones Act issues related to emergency support	no	process there but political realities impede use
Policy	*Land use plan*	Building again in high-hazard area (i.e., schools, hospital, NWS)	Enforce sensible use of land use plan and zoning; assess on paper but in reality is different (i.e., zoning)	Enforce code, consistency in code, implement new code. 1. approve new land use regulations with strong focus on risk zones	no change	

	People inadequately prepared for Categories 4 or 5 hurricanes	Prior close calls gave a false sense of security & resources were moved to VI to deal with Irma	Should prepare regardless of category level	Education / outreach, use Maria as an example while fresh in memories, For Tsunami: prepare models and videos of what it would look like (overlay culturally significant places), storm surge water marks / signage (Keep reminders of physical damage), Art projects. Media and education campaign	Tsunami = preparing for something you haven't experienced, increased challenge -	
Preparedness	**Lack of Emergency planning**	Starting from family, community, local, regional.	Local level preparedness plan created with central point of information. Need accountability w.r.t. response plans. Pre-emergency planning to include local law enforcement and impartial parties (e.g., NGO, faith based organizations)	Table top exercise to improve plan, use available funding and follow through, involve local level. creative solutions like addressing faith based orgs), capitalizing on existing program infrastructure, community leaders, create plans in daily life (daycare, work, school with continuity)	Some - hurricane gives family level planning, Tsunami = "save self mindset",	

Group B

Challenge Category	Identified Response Challenge	Explanation/ Description	Lessons Learned	Improvement(s) (Actionable Tasks)	How does approach change with respect to Tsunami vs. Hurricane	Comments
Communication	*Communication with small communities*	Lacked proper terminology to inform community	Post emergency communication needs to be simple and tailored to community (municipalities)	Be aware of language and culture needs. Post flyers. Centralized information in public location. Verifying the community leaders. Pre-training at the community level.	Both	What to do if community is totally isolated and unable to access information.
Policy	*Policy guidelines need to be revisited due to change and new technology, climate change etc.*	Better integrate green technologies, climate change considerations into existing policies for funding and mitigation.	These policies need to be revised before an incident	High-level policy agreement on existing FEMA public assistance, mitigation and recovery policies.	Both	Coasts on island are particularly important.

	Other Funding Agencies (OFA) need to be assertive in their supplemental funding requests	There are some things FEMA cannot fund	you snooze, you lose	Use consistent vocabulary. Agencies should be responsible/aware for their own coverage/vocabulary. Host workshops/training on funding/grant writing/petitions/procurement/opportunities. Include the local emergency coordinators along with the state and mayors at annual meeting for training (not limited to local authority).Training of federal grant submission (preparedness).Improve liaison outreach/communication.	Both	This might be unique to Puerto Rico.
Preparedness	**People inadequately prepared for Categories 4 or 5 hurricanes**	Prior close calls gave a false sense of security & resources were moved to VI to deal with Irma	Should prepare regardless of category level	Social scientists may be able to help with effective, engaged outreach. Education and buy-in from local community leaders. More effective exercises esp. on the items we did wrong previously (i.e., AAR). Don't let AAR sit on a shelf; reassess. Develop a checklist of activities.	Both	

Response	***Rapid assessments of damage/debris were critical. Be bold on initial assessment***	Baseline for FEMA to consider funding opportunities.	Areas/communities that had quick assessments made it easier to scope federal funding	Centralized application to collect assessment information multiple sectors. The public can report on their municipalities.	Both	This goes beyond just FEMA. Post and report storm information i.e., #hurricanemaria (include GPS). Post-Tsunami survey guide is available. Language and culture must be taken into consideration.
Inequity	Vulnerable population	Disabled/sick/elderly people were stuck in place	Don't wait until hospital is impacted to make decisions/hospital need redundant or back up energy sources			

Group C

Challenge Category	Identified Response Challenge	Explanation/ Description	Lessons Learned	Improvement(s) (Actionable Tasks)	How does approach change with respect to Tsunami vs. Hurricane	Comments
Communication	***Communication with small communities***	Lacked proper terminology to inform community	Post emergency communication needs to be simple and tailored to community	Use of short wave radios (response), sat internet, power (generators)	same for both	

	Contingency planning for emergency communication	Back up communication routes, diverse ways to request help (e.g., internet not available)	Need more than standard communication (e.g., radio, paper map, ham radio)	Need of education on the technology used (be outside, pay fees for services), need power for sat phone, UHF, PA systems, use phones as communication with low wattage , solar powered hard drives	same for both	Invest and investigate in technologies, government can't fund all of it
	Lack of Emergency planning	Starting from family, community, local, regional.	Local level preparedness plan created with central point of information. Need accountability w.r.t. response plans. Pre-emergency planning to include local law enforcement and impartial parties (e.g., NGO, faith based organizations)	Aggressive on pre plan- what is already there, educate the community, what should they do with supplies (have it ready before the event- bag of supplies, food, water, communication tools, etc.), have to train people on the concept	same for both	More focus on the lower levels of preparedness (families, communities, etc.)
Response	*Rapid assessments of damage/debris were critical. Be bold on initial assessment*	Baseline for FEMA to consider funding opportunities	Areas that had quick assessments made it easier to scope federal funding	Require prior base line, municipalities needed, pre plan for what we need to do (before and after), takes time for some response (why preparedness is so important), be able to grow food, apply for grants to building sick bank, communication center, etc.	same for both	

| Inequity | *Vulnerable population* | Disabled/sick/ elderly people were stuck in place | Don't wait until hospital is impacted to make decisions/hospital need redundant or back up energy sources | Better assessment of who's at risk (people in hospitals, nursing homes, etc.) | same for both | |

Group D

Challenge Category	Identified Response Challenge	Explanation/ Description	Lessons Learned	Improvement(s) (Actionable Tasks)	How does approach change with respect to Tsunami vs. Hurricane	Comments
Communication	*Communication with small communities*	Lacked proper terminology to inform community	Post emergency communication needs to be simple and tailored to community	1. Take information to community, and ask for feedback. 2. Which sources of social media are used? 3. Investigate which app are applicable to community, and use contact point to distribute information 4. pick a central location/focal point to distribute information and time for briefing	n/a	(e.g., school, churches, plaza)
	Communities relying on social media and not official sources of information	Lack of exposure for official sources, too much exposure for other information	More outreach about what official sources of information are	1. do community outreach on official sources of information, who and how to access official information	increase use of tsunamiready guidelines, WEA	

	Contingency planning for emergency communication	Back up communication routes, diverse ways to request help (e.g., internet not available)	Need more than standard communication (e.g., radio, paper map, ham radio)	1. Encourage folks to get amateur/ham radio license. 2. preposition sat phones, work with technology companies to develop low tech solutions 3. training/drills	useful for both situations	encourage regular drills, practices to maintain capabilities
	Communication of the severity danger/potential risk	Having public understand the risk; people think they are lucky, manage expectations, warning fatigue. "Burn out"- desensitizing of alarms	Because of the size of the island, confidence in the forecast/warning; people get desensitized with many hurricanes missing Puerto Rico; so many warnings with nothing happening, people choose not to respond. Take culture into account when designing communication lines	1. Show damage from previous storms, and consistent messaging each season. 2. less emotion when messaging, keep message calm to prepare rather than scare community	same for both	
Infrastructure	*Lack of and enforcement of residential building codes*	Building codes not enforced, and people did not understand homes were unsafe	More damage and loss of life due to unsafe structures	1. Messaging related to maintaining a safe structure, not exclusively collecting water. 2. Critical infrastructure should be evaluated 3. Properly use federal funds to repair and maintain infrastructure 4.	same for both	dept. of transportation

				professional education, assessment of curriculum in all academic settings		
	Lack of access to clean water	No redundant water for residents/no cisterns	Ran out of water	1. Education on rainwater harvesting, the importance of it. 2. Improve residential water collection to maintain a reserve. 3 education on low cost filters (e.g., sand). 4. Education on maintenance of individual water sources. 5. proper installation of tanks/cisterns	same for both	
Logistics	*Port accessibility is limited during response because of existing laws*	San Juan is major port for food/resources coming to PR. Other ports are used for petroleum products, coal.	Necessary aid could not be distributed/get to local communities quick enough. Circumvent barriers using emergency declaration to streamline that (e.g., turn off taxation during response.)	1. Landside facilities are geared toward handling only one type of commodity, 2. Require private ports to be capable, and ready to act in the case of a disaster. 3. identify alternate airports/transportation that would be viable in event of storm	same for both	Major airport is in splash zone for tsunami. Potential to stage resources
	Marine/land debris hindered by lack of staging areas and logistics	See Florida plans for an example	Need pre-identified staging areas	1. Having a plan for where to put marine debris, 2. Destroyed buildings/construction materials, 3. identify final location for debris (e.g., landfill vs. taking off island)	same for both	see x-prize winner

Preparedness	*Lack of Emergency planning*	Starting from family, community, local, regional.	Local level preparedness plan created with central point of information. Need accountability w.r.t. response plans. Pre-emergency planning to include local law enforcement and impartial parties (e.g., NGO, faith based organizations)	1. Re-institute CERT program in schools, churches, communities, 2. Use in coordination with neighborhood watch programs, 3. use "nextdoor" type apps,	same for both	
	Lack of pre-scripted mission assignments	Minimize duplicity of efforts	The more pre-scripted mission assignments, the quicker response activities can commence and provides training opportunities within agencies	1. Do more outreach with state/territory/govt level to educate about what they can ask for in terms of mission assignments 2. looking back at historical lessons, to drive assessments	same for both	
Inequity	*Vulnerable population*	Disabled/sick/ elderly people were stuck in place	Don't wait until hospital is impacted to make decisions/hospital need redundant or back up energy sources	1. Census data/demographic data to focus efforts and identified during emergency preparedness planning to create a special needs plan. 2. Compliance checks done in low income communities, first. 3. Recommendations for	Evacuation plan may vary between T and H	Time of day may influence who is present in the community, family plan would identify who is

				improvements rather than fines. 4. Messages tailored to underserved communities.		available during the day vs. night.

Appendix D – Breakout Session III

Group A

Challenge Category	Identified Response Challenge	Explanation/ Description	Lessons Learned	Recommendation for Implementation	Ease of Implementation (1=easy, 5= hard)	Coordination w. Partners
Communication	*Communication with small communities*	Lacked proper terminology to inform community	Post emergency communication needs to be simple and tailored to community	1a. Evaluate/find existing data (private and public), (identify orgs already doing work in community) 1b. Visiting communities to document needs and points of contact (2)	2.5	Academia, NGOs, Community based orgs with established gov/commonwealth/territory partnership for information sharing
	Communities relying on social media and not official sources of information	Lack of exposure for official sources, too much exposure for other information	More outreach about what official sources of information are	1. team (graphic artist, website builder, science communication expert, marketing specialist, social media expert)	1	PREMA & VITEMA, academia or other private partners at local level
Infrastructure	*Lack of access to clean water*	No redundant water for residents/no cisterns	Ran out of water	1. create tax incentives to make collection/filtration more widespread 2.educate on proper use of water catchment filtration systems	1. 2.5 2. 1	Homeowner association, private industry, engineering organizations, academia, government, SME (Small Medium Enterprise) incubators

	Current infrastructure was/is not hurricane ready	roads, power lines, etc.	maintain/update infrastructure to withstand hurricanes			
	Poorly maintained infrastructure	E.g., failure of infrastructure (water); waiting for govt to maintain infrastructure	Empowering communities to take accountability/responsibility of infrastructure	Create courses and certifications, mandate training. Build cat 4&5 rated buildings and implement best practices for Tsunami resilience	4	Government and engineering organizations, insurance industries, community involvement/participation
Leadership	*High turnover within leadership position and trained personnel; limited capacity for multiple, simultaneous disasters*	Competition for resources. Trained/experienced resources. Turnover of political/experienced/burn out staff. Don't restructure the organization during a disaster	Climate change could lead to stressors to staff/resources/retention. Need local level leaders- educated through trainings. Minimize turnover.	1. curriculum development (at all levels)	2.5	Academia & dept. of education

Logistics	*Port accessibility is limited during response because of existing laws*	San Juan is major port for food/resources coming to PR. Other ports are used for petroleum products, coal.	Necessary aid could not be distributed/get to local communities quick enough. Circumvent barriers using emergency declaration to streamline that (e.g., turn off taxation during response.)	1. conduct study and analyze potential impacts of change	Study=1 Change = 5	Academia, think-tank
Policy	*Land use plan*	Building again in high-hazard area (i.e., schools, hospital, NWS)	Enforce sensible use of land use plan and zoning; assess on paper but in reality is different (i.e., zoning)	1. Meet with risk experts and planning board to ensure best practices	4	local and state gov., (Permitting agencies, municipalities), community feedback
Preparedness	*People inadequately prepared for Categories 4 or 5 hurricanes*	Prior close calls gave a false sense of security & resources were moved to VI to deal with Irma	Should prepare regardless of category level	Community involved: award competitions for campaign, education outreach all ages involved. Conduct for both hurricane and tsunamis at schools, mass media, higher ed. Institutions	2.5	All

	Lack of Emergency planning	Starting from family, community, local, regional.	Local level preparedness plan created with central point of information. Need accountability w.r.t. response plans. Pre-emergency planning to include local law enforcement and impartial parties (e.g., NGO, faith based organizations)	project based learning platforms, find and edit existing checklists that can be PR relevant and distribute, emulate other places with similar programs, Create emergency management education program for communities at all levels year-round	2.5	All

Group B

Challenge Category	Identified Response Challenge	Explanation/ Description	Lessons Learned	Recommendation for Implementation	Ease of Implementation (1=easy, 5= hard)	Coordination w. Partners
Communication	Communication with small communities	Lacked proper terminology to inform community	Post emergency communication needs to be simple and tailored to community (municipalities)	In community workshops with community leaders and focus on rural and underserved communities.	2	NGOs, local emergency mgmt. organizations, faith-based orgs, schools & universities.

Policy	Policy guidelines need to be revisited due to change and new technology, climate change etc.	Better integrate green technologies, climate change considerations into existing policies for funding and mitigation.	These policies need to be revised before an incident	GAO-focus group. Agency feedback to GAO and FEMA. Agencies/academia provide information on how green infrastructure fits into FEMA facilities.	4	Federal agency. Ongoing GAO focus group on Maria. Universities
	Other Funding Agencies (OFA) need to be assertive in their supplemental funding requests	There are some things FEMA cannot fund	You snooze, you lose	Interagency training on procedures of funding opportunities. Create a survey (to commonwealth agencies) to gather post-event lessons learned on supplemental grant processes. Federal agencies aware of supplemental funding opportunities (grant, special project funding) and responsible for requests relative to their mandates. Federal agencies should be prepared with requests to	3	Federal agencies. Commonwealth is unique in that funding budget does not allow for

				Congress for supplemental funding according to their agency mandates.		
Preparedness	*People inadequately prepared for Categories 4 or 5 hurricanes*	Prior close calls gave a false sense of security & resources were moved to VI to deal with Irma	Should prepare regardless of category level	Social science (this is not a technical problem) how we can improve transfer of information. Research the effectiveness of training/translation. Implement NWS Storm Ready. Expand CERT to include specific training to community (i.e., storm surge, flood)	4	YES (NWS etc.)
	Lack of pre-scripted mission assignments	Minimize duplicity of efforts.	The more pre-scripted mission assignments, the quicker response activities can commence and provides training opportunities within agencies	Agencies review what they have currently. Agencies develop new ones as appropriate. Conduct exercise to review and update PSMAs. Develop checklist for	3	Federal Agencies, state and local

				the state to use to make requests. Recommend to GAO?		
Response	*Rapid assessments of damage/debris were critical. Be bold on initial assessment*	Baseline for FEMA to consider funding opportunities.	Areas/communities that had quick assessments made it easier to scope federal funding	Implement #hashtag. Field exercise like CARIBEWAVE. Develop app (see SERT-FL).	2	Coordinators, NWS, FEMA, multi-agencies.

Group C

Challenge Category	Identified Response Challenge	Explanation/ Description	Lessons Learned	Recommendation for Implementation	Ease of Implementation (1=easy, 5= hard)	Coordination w. Partners
Communication	*Communication with small communities*	Lacked proper terminology to inform community	Post emergency communication needs to be simple and tailored to community	Equipment compatibility	3	state level

	Contingency planning for emergency communication	Back up communication routes, diverse ways to request help (e.g., internet not available)	Need more than standard communication (e.g., radio, paper map, ham radio)	Training and education, map of who is able to educate. Being able to buy, use, and maintain the equipment. Use universities	4	state level
Policy	*Interpersonal- layers of bureaucracy slowed progress*	Politics getting in the way of progress	Need to identify an authority- in past only identified problem	People need to know their jobs (checklist), communication to avoid different decisions being made, held accountable by making sure people report problems (investigation), teams of public oversight to help. This might not help everyone but it could in the future. Turn over the information to theirs and new leaders (who has that information for when you are gone?)	4	all levels (state municipalities)
	Lack of Emergency planning	Starting from family, community, local, regional.	Local level preparedness plan created with central point of information. Need accountability w.r.t. response plans. Pre- emergency planning to include local law enforcement and impartial	(1) Educate- workshops to build the knowledge for the local leaders to bring back to their communities (ex. kids can take it home to their families), break up the workshops into regions to allow more people to attend (for different cultures), NOAA office for coastal management. (2) Outreach- media blitz (ads at the movies, on roads, radios, TV stations, at stores), public and private classes (home improvement stores), youth organizations (boy scouts, girl scouts, etc.), these need to be on how to prepare for these events. (3) Goal is to create self-sufficient communities. Put	3	community levels, NGO, Universities , media outlets, photo journalist workshops

			parties (e.g., NGO, faith based organizations)	people on the ground in pilot communities (more difficult to implement but more results), share the results!		
Response	*Rapid assessments of damage/debris were critical. Be bold on initial assessment*	Baseline for FEMA to consider funding opportunities	Areas that had quick assessments made it easier to scope federal funding	Assessments, inventory, create culture	4.5	communities, state, and municipalities
Inequity	*Vulnerable population*	Disabled/sick/ elderly people were stuck in place	Don't wait until hospital is impacted to make decisions/hospital need redundant or back up energy sources		2	all levels

Group D

Challenge Category	Identified Response Challenge	Explanation/Description	Lessons Learned	Recommendation for Implementation	Ease of Implementation (1=easy, 5=hard)	Coordination w. Partners
Communication	*Communication with small communities*	Lacked proper terminology to inform community	Post emergency communication needs to be simple and tailored to community	Be targeted (e.g., agencies and groups developing message, can plan events such as town hall) and opportunistic (e.g., if community is having an event, use the event to share information). Use an event organized by the community (especially with food and activities)	2.5	Communities/municipalities leaderships (e.g., mayor, elected political officials); grassroots community organizations (e.g., churches). Official message developers (e.g., NWS, FEMA, local emergency management- PREMA, VITEMA). SeaGrant
	Communities relying on social media and not official sources of information	Lack of exposure for official sources, too much exposure for other information	More outreach about what official sources of information are	Be targeted (e.g., agencies and groups developing message, can plan events such as town hall) and opportunistic (e.g., if community is having an event, use the event to share information). Use an event organized by the community (especially with food and a	2.5	Pre- events --> same partners as Comm 2

Contingency planning for emergency communication	Back up communication routes, diverse ways to request help (e.g., internet not available)	Need more than standard communication (e.g., radio, paper map, ham radio)	Connect with university/radio clubs. Identify funding source/opportunities. Demonstrations to solicit interest, go to events and set up table. Stories/outreach about why some communities were better off post disaster because had sat phones/ham. Continuing education, training	5 (technical skills and need buy in, might still be problem with sat phone in PR)	Federal communications commission (FCC), ARRL - amateur radio relay league, emergency management agency, amateur radio clubs, local technical university (e.g., electrical engineering)
Communication of the severity danger/potential risk	Having public understand the risk; people think they are lucky, manage expectations, warning fatigue. "Burn out"- desensitizing of alarms	Because of the size of the island, confidence in the forecast/warning; people get desensitized with many hurricanes missing Puerto Rico; so many warnings with nothing happening, people choose not to respond. Take culture into account when designing communication lines	Create traveling exhibit of how things went wrong and why you should be prepared; vivid, be targeted and opportunistic. Creating videos/photo show	2.5	Communities/municipalities leaderships (e.g., mayor, elected political officials); grassroots community organizations (e.g., churches). Official message developers (e.g., NWS, FEMA, local emergency management- PREMA, VITEMA). SeaGrant

Infrastructure	**Lack of and enforcement of residential building codes**	Building codes not enforced, and people did not understand homes were unsafe	More damage and loss of life due to unsafe structures	Detailed assessment of critical infrastructure; meeting with engineers/architects in municipalities to go around communities to identify most important aspect of a structure. Different source of funding for public, private and municipal	5	Municipal architects/engineers; FEMA capacity build sector;
	Lack of access to clean water	No redundant water for residents/no cisterns	Ran out of water	New construction require redundant water systems, existing construction improve collection systems, create document/demonstration for rainwater harvesting; low cost, implement at a few locations within the community to encourage community members to copy. educating about how to clean water/maintain system	sliding scale (depends on technology of choice)	local water company, non-profits, private business, commonwealth/territory/municipality responsible for building codes
Logistics	**Port accessibility is limited during response because of existing laws**	San Juan is major port for food/resources coming to PR. Other ports are used for petroleum products, coal.	Necessary aid could not be distributed/get to local communities quick enough. Circumvent barriers using emergency declaration to streamline that	Have diverse ports, capable of handling other goods; back-up port for response operations. Policy shift by port authority by diversifying use of port. Contingency plans to have more than one viable port available.	5	port authority, govt of PR, private industry

		(e.g., turn off taxation during response.)			
	Marine/land debris hindered by lack of staging areas and logistics	See Florida plans for an example	Need pre-identified staging areas	Identifying locations ahead of time in contingency plans,	1.5-2	FEMA, USCG, local agencies, NOAA Marine Debris, Public Works
	Lack of Emergency planning	Starting from family, community, local, regional.	Local level preparedness plan created with central point of information. Need accountability w.r.t. response plans. Pre-emergency planning to include local law enforcement and impartial parties (e.g., NGO, faith based organizations)	Look to VITEMA model to replicate, find more avenues of socializing information; demonstrations in communities during events, continued community outreach. Improve consistency of delivery. Institutionalizing self-reliance (i.e., stop relying on federal govt to make fixes)	1.5-2	Local agencies, emergency management agencies, FEMA, school system/education system, community members

	Lack of pre-scripted mission assignments	Minimize duplicity of efforts	The more pre-scripted mission assignments, the quicker response activities can commence and provides training opportuntities within agencies	keep hazard mitigation plan up to date. educate commonwealth about FEMA missions to determine what can be asked for. FEMA relies on guidance from local govt level. Inform what can be asked for (e.g., guidance document/ lessons learned)	5	Commonwealth/local govt (e.g., hazard mitigation office), FEMA, local management agencies (e.g., coastal agencies, all-encompassing plan), port authorities, schools, local chamber of commerce, private businesses
	Private sector was not pre-emptively involved	Private sector often has resources it can contribute to response effort- have resources and assets connected at all levels.	Involve private sector during contingency plans. Make the link on how to support municipalities/local organizations (e.g., transportation/ gas/food)	Multiple companies get hired or one primary contractor with sub-contractors. Advanced contracting initiatives for pre-planned contracts. List for potential companies available if needed pre-,during, post-disaster	sliding scale	private businesses, local govt, contractors
Inequity	*Vulnerable population*	Disabled/sick/ elderly people were stuck in place	Don't wait until hospital is impacted to make decisions/hospital need redundant or back up energy sources	If municipalities' emergency contingency plans don't exist, then develop and identify vulnerable population(s). If they do exist, include in them.	5	census bureau, social services, health and human services, local law enforcement, local emergency response management, planning and development agency

Appendix E: Training Presentations

Tsunami Risk Communication Exercise

NOAA NRPT LEARNING FROM THE PAST AND MOVING FORWARD: RESPONSE CHALLENGES FROM SEVERE WEATHER OR TSUNAMIS TO SHARED TRUST RESOURCES AND MISSION RESPONSIBILITIES
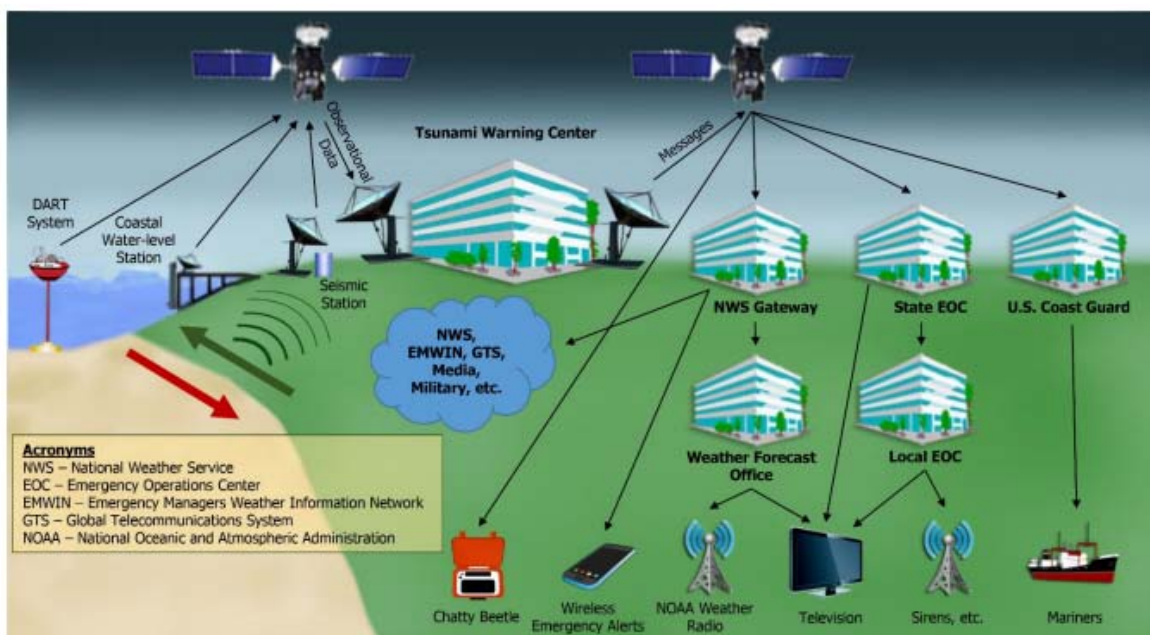
San Juan, PR

April 23-25, 2019

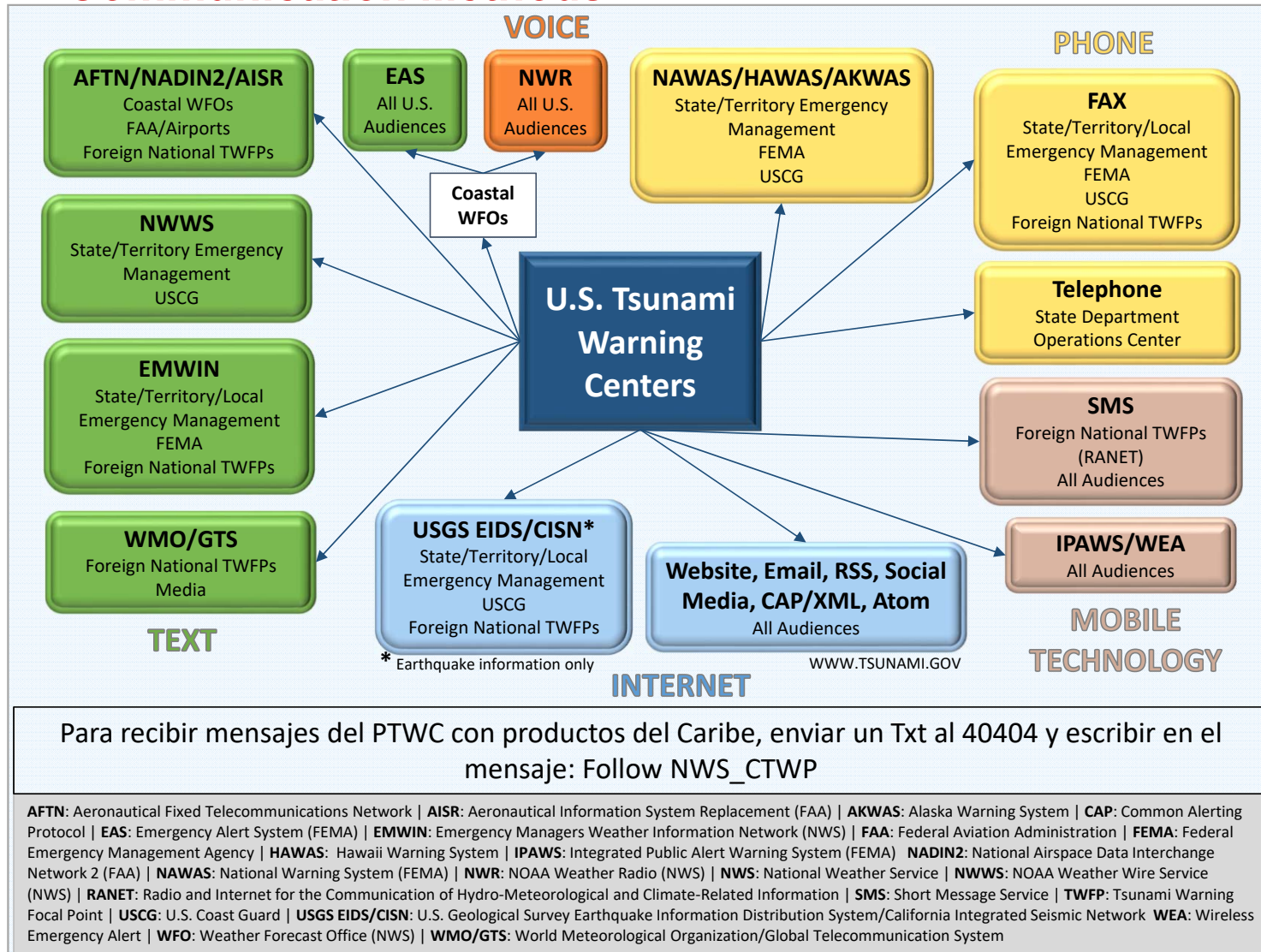Christa von Hillebrandt-Andrade and Carolina Hincapié

NOAA NWS Caribbean Tsunami Warning Program

U.S. Tsunami Warning System Communications Diagram

http://tsunami.gov

Communication Methods

VOICE

AFTN/NADIN2/AISR
Coastal WFOs
FAA/Airports
Foreign National TWFPs

EAS
All U.S. Audiences

NWR
All U.S. Audiences

NAWAS/HAWAS/AKWAS
State/Territory Emergency Management
FEMA
USCG

PHONE

FAX
State/Territory/Local Emergency Management
FEMA
USCG
Foreign National TWFPs

Coastal WFOs

U.S. Tsunami Warning Centers

NWWS
State/Territory Emergency Management
USCG

Telephone
State Department Operations Center

EMWIN
State/Territory/Local Emergency Management
FEMA
Foreign National TWFPs

SMS
Foreign National TWFPs (RANET)
All Audiences

WMO/GTS
Foreign National TWFPs
Media

USGS EIDS/CISN*
State/Territory/Local Emergency Management
USCG
Foreign National TWFPs

Website, Email, RSS, Social Media, CAP/XML, Atom
All Audiences

IPAWS/WEA
All Audiences

MOBILE TECHNOLOGY

TEXT

* Earthquake information only

WWW.TSUNAMI.GOV

INTERNET

Para recibir mensajes del PTWC con productos del Caribe, enviar un Txt al 40404 y escribir en el mensaje: Follow NWS_CTWP

AFTN: Aeronautical Fixed Telecommunications Network | **AISR**: Aeronautical Information System Replacement (FAA) | **AKWAS**: Alaska Warning System | **CAP**: Common Alerting Protocol | **EAS**: Emergency Alert System (FEMA) | **EMWIN**: Emergency Managers Weather Information Network (NWS) | **FAA**: Federal Aviation Administration | **FEMA**: Federal Emergency Management Agency | **HAWAS**: Hawaii Warning System | **IPAWS**: Integrated Public Alert Warning System (FEMA) **NADIN2**: National Airspace Data Interchange Network 2 (FAA) | **NAWAS**: National Warning System (FEMA) | **NWR**: NOAA Weather Radio (NWS) | **NWS**: National Weather Service | **NWWS**: NOAA Weather Wire Service (NWS) | **RANET**: Radio and Internet for the Communication of Hydro-Meteorological and Climate-Related Information | **SMS**: Short Message Service | **TWFP**: Tsunami Warning Focal Point | **USCG**: U.S. Coast Guard | **USGS EIDS/CISN**: U.S. Geological Survey Earthquake Information Distribution System/California Integrated Seismic Network **WEA**: Wireless Emergency Alert | **WFO**: Weather Forecast Office (NWS) | **WMO/GTS**: World Meteorological Organization/Global Telecommunication System

Shorter Messages

- Order of Message Content is Important
- 90 characters (current WEA):
  - Source, guidance, hazard, location, time
- 280 – 360 character (eg. Twitter):
  - Source, hazard, location, time and guidance

NOAA Central Library: Creating Alerts and Warnings for Short Messaging Channels
Speakers: Jeannette Sutton, Ph.D., Associate Professor, Department of Communication, University of Kentucky & Erica Kuligowski, PhD, Research Social Scientist, Engineering Laboratory, National Institute of Standards and Technology, April 24, 2019

https://www.youtube.com/watch?v=MH3uBclHezE

Wireless Emergency Alerts

- **Current: Tsunami danger on the coast. Go to high ground or move inland. Listen to local news. –NWS**

- Proposed (English/Spanish):

    NWS: Tsunami danger on the coast. Move to high ground or inland now.

    SNM: Peligro de tsunami. Vaya a un lugar alto o tierra adentro ahora.

- Proposed (Longer Message English/Spanish)

    The National Weather Service has issued a tsunami warning. A series of powerful waves and strong currents may impact coasts near you. You are in danger. Get away from coastal waters. Move to high ground or inland now. Keep away from the coast until local officials say it is safe to return. Check local media for more information after you are safe.

    El Servicio Nacional de Meteorología ha emitido un aviso de tsunami. Olas y corrientes fuertes pueden afectar costas cercanas. Está en peligro. Aléjese de aguas costeras. Muévase ahora a un lugar alto o tierra adentro. Manténgase alejado hasta que las autoridades locales indiquen que es seguro regresar. Verifique información oficial una vez esté seguro.

Official Roles for Tsunami Warning Process

- Tsunami Warning Center – Responsible for determining alert level and issuing message
  - Pacific Tsunami Warning Center
- Tsunami Warning Focal Point – Responsible for disseminating Official Alerts to authorities and public
  - PR State Emergency Management Bureau is the Primary Tsunami Warning Focal Point for Puerto Rico, IPAWS (WEA), VHF Radio
  - VITEMA/911 is the Primary Tsunami Warning Focal Point for US Virgin Islands
  - NWS SJFO – Secondary Tsunami Warning Focal Point for PR and USVI – activate NOAA Weather Radio and EAS, Social Media
  - PRSN – Secondary Tsunami Warning Focal Point for PR and USVI, RSS, Website, Social Media, VHF Radio, Ham Radio
- USCG – Responsible for disseminating alert to boaters/maritime community

Roles During Exercise

- CTWP act as PTWC

- TWFP act as TWFP

- USCG acts as USCG

- Others are Social Influencers during warning, assume agency roles from Cancellation onward

- Define where you are in PR/VI or outside of PR

Enabling Learning Objectives

1. Familiarization with Tsunami Warning Center products and timelines

2. Improve the communication of the threat message in PR/USVI by official TWFP and social influencers.

3. Will focus on four stages of warning:
   - Response to Earthquake shaking
   - Tsunami Warning
   - Tsunami Confirmation
   - Warning Cancellation
   - All Clear

Overview and Instructions

- Comms based on natural signs (Activity 1 – 30 min)
- Comms with Message #1 (Activity 2 – 30 min)
- Comms with Message # 3 (Activity 3 – 30 min)
- Comms with Message # 8 (Activity 4 – 30 min)
- Comms for Response/All Clear (Activity 5 – 30 min)

- Working Groups established previously – ONLY Activity 1 to do individually.
- No communication between groups or consultation with facilitators.
- Mimic time during real event
- Write down your responses/message according to the time stipulated.

Group Learning Scenario Exercise
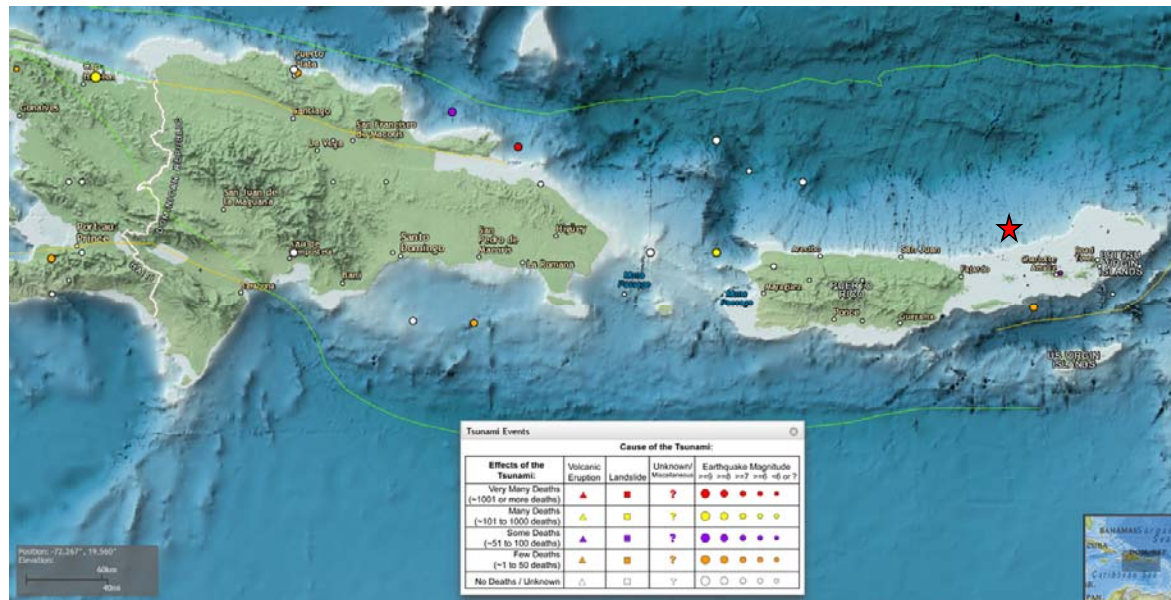
- Activities simulate M7.9 earthquake NE of Puerto Rico
- Earthquake occurs in Puerto Rico Trench, where North American Plate subducts under Caribbean Plate

Scenario Activity 1

- Strong earthquake shaking is felt, 11:00 PM

- Some buildings have collapsed.

- Phones lines are immediately jammed as everyone tries to find out what happened.

- No TWC messages have been issued yet.

Scenario Activity 1 Questions

Including earthquake, you have 3 minutes for action (all individual), 20 minutes group discussion

1. How do you respond to the earthquake?
2. What do you think is going to happen, number the risks.
3. What can you communicate, to Who and How are you going to do it.

Tsunami Warning Focal Point respond as Tsunami Warning Focal Point, USCG as USCG others as a social influencer

Scenario Activity 2

- Time 11:03

- PTWC message #1 issued

- Telephones are jammed, Social Media is viral

- Earthquake impact has been significant.

Scenario Activity 2 Questions

5 minutes to determine action, 15 minutes group
discussion

1. What and How did you receive the official product?
2. What is the alert level?
3. What is the expected time of arrival of the tsunami?
4. What, to Who, How and When are you going to
    communicate.

Tsunami Warning Focal Point respond as Tsunami
Warning Focal Point, USCG as USCG others as a social
influencer

Scenario Activity 3

- It is 11:55 PM

- PTWC message #3 is issued

- Media reports the tsunami is inundating the U.S. Virgin Islands and Puerto Rico.

- Media reports people flocking to beaches to watch the arrival of the tsunami. This is causing coastal evacuation problems.

Scenario Activity 3 Questions
5 minutes for action, 15 minutes group discussion

1. What important new information does the message include?

2. What, to Who, How and When are you going to communicate.

Tsunami Warning Focal Point respond as Tsunami Warning Focal Point, USCG as USCG, others as a social influencer

Scenario Activity 4

- It is 0225 AM

- PTWC message #8 is issued

- Media reports the tsunami has inundated Puerto Rico coasts.

- People are wanting to enter to the evacuated areas.

Scenario Activity 4 Questions

5 minutes for action, 5 minutes group discussion

1. What important new information does the message include?

2. What, to Who, How and When are you going to communicate.

Tsunami Warning Focal Point respond as Tsunami Warning Focal Point, USCG as USCG, others as a social influencers/assume agency role

Scenario Activity 5

- PR Governor press conference at 7 AM

- Initial report of the event and its effects.

- Informs that EM Officials are in field doing the corresponding evaluations and will be issuing the all clear in a further intervention.

- Curfew for other citizens

Scenario Activity 5 Questions

10 minutes for group discussion

1. What is the government guidance?

2. What are additional information sources?

3. What, to Who, How and When are you going to communicate.

4. What will be the roles in response?

Everyone assumes agency role

Summary

- Discussed the impact of a local tsunami to at-risk tsunami communities along the coast.

- Examined the types of Tsunami Warning Center messages in the scenario

- Considered type, timing, audience and mechanism for communications

Hurricane Exercise

**NOAA Regional Preparedness
and Training (NRPT)**

April 25, 2019

Guaynabo, PR

WFO San Juan

EXERCISE OBJECTIVE

- Provide an opportunity to familiarize with the **NOAA National Weather Service** and **NOAA National Hurricane Center** products during the preparation, response and recovery phase from a major hurricane that impacted Puerto Rico.

- Explain Hurricane Threats based on the reasonable worst-case scenario using plain language.

- Understand the time in which individuals can safely assume they will have to prepare for TC force winds.

WFO Knowledge of Potential Peak Impacts

Very Long-term
Climatology/ Statistics, Seasonal Outlooks, Preparedness Talks, MOM

Long-term
HWO, PNS, EM Briefings, Media Interviews, Social Media, NHC Wind Speed Probabilities (5 days), MOM, MEOW

Long-term
Hurricane Watch, Hurricane Warning, HLS, TCV, EM Briefings, Media Interviews, Social Media, NHC Wind Speed Probabilities, Probabilistic Storm Surge, Potential Storm Surge Flooding Map

Short-term
HLS, TCV, and other short-term products

WFO Knowledge

Very Short-term
EWW

User Needs - Plan/Prepare | **Implement According to Plan** | **Last Chance** | **Recovery**

| 168 | 120 | 72 | 48 | 36 | 24 | 12 | 6 | 3 | 1 | 0 | Hours Until Peak Impact |
| Day 7 | Day 5 | Day 3 | Day 2 | | Day 1 | | | | | | |

NWS/NOAA

WFO San Juan

Disturbance 1

Tropical Weather Outlook
NWS National Hurricane Center Miami FL
800 AM EDT Thu Sep 14 2017

For the North Atlantic...Caribbean Sea and the Gulf of Mexico:

The National Hurricane Center is issuing advisories on Hurricane
Jose, located several hundred miles east-northeast of the
southeastern Bahamas.

1. A tropical wave located about 800 miles southwest of the Cabo Verde
Islands continues to produce widespread showers and thunderstorms.
Environmental conditions are expected to be conducive for gradual
development of this system, and a tropical depression could form
early next week while it moves westward at around 15 mph across the
tropical Atlantic.
* Formation chance through 48 hours...low...20 percent.
* Formation chance through 5 days...medium...60 percent.

8:00 am EDT
Thu Sep 14 2017

1
(60%)

Current Disturbances and Five-Day Cyclone Formation Chance: ✖ < 40%   ✖ 40-60%   ✖ > 60%
Tropical or Sub-Tropical Cyclone: ◯ Depression   ⑥ Storm   ⑥ Hurricane
⊗ Post-Tropical Cyclone   ✕ Remnants

WFO San Juan

Tropical Weather Outlook
NWS National Hurricane Center Miami FL
200 AM EDT Fri Sep 15 2017

For the North Atlantic...Caribbean Sea and the Gulf of Mexico:

The National Hurricane Center is issuing advisories on Tropical
Storm Jose, located over the southwestern Atlantic Ocean, and on
newly developed Tropical Depression Fourteen, located over the
eastern Atlantic Ocean.

1. A tropical wave located about 1200 miles east-southeast of the
Lesser Antilles continues to produce disorganized showers and
thunderstorms. Environmental conditions are expected to be
conducive for gradual development, and a tropical depression is
likely to form early next week. Interests in the Lesser Antilles
should closely monitor the progress of this system while it moves
westward to west-northwestward at about 15 mph.
* Formation chance through 48 hours...medium...40 percent.
* Formation chance through 5 days...high...80 percent.

Tropical Weather Outlook
NWS National Hurricane Center Miami FL
200 AM EDT Sat Sep 16 2017

For the North Atlantic...Caribbean Sea and the Gulf of Mexico:

The National Hurricane Center is issuing advisories on Hurricane Jose, located several hundred miles southwest of Bermuda, and on Tropical Depression Fourteen, located over the eastern Atlantic Ocean.

1. Showers and thunderstorms associated with a tropical wave located about 800 miles east of the Windward Islands have continued to become better organized. Environmental conditions are conducive for additional development and a tropical cyclone could form at any time today or Sunday so while the system moves westward or west-northwestward around 20 mph. Interests in the Lesser Antilles and northeastern Caribbean should closely monitor the progress of this system. Tropical storm or hurricane watches could be issued for portions of the Lesser Antilles later this morning.
* Formation chance through 48 hours...high...90 percent.
* Formation chance through 5 days...high...90 percent.
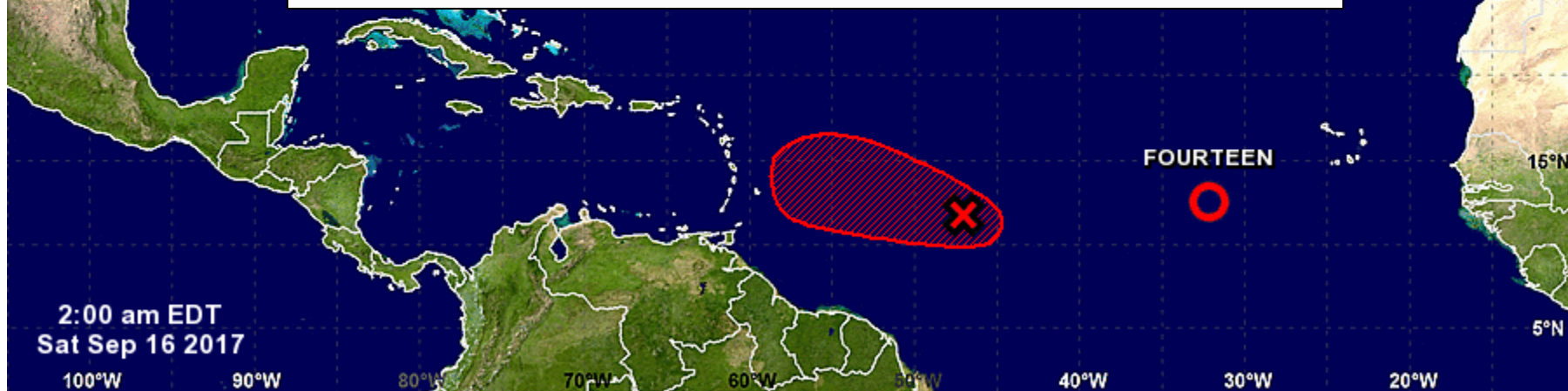
All Disturbances

www.hurricanes.gov

FOURTEEN

2:00 am EDT
Sat Sep 16 2017

Current Disturbances and Five-Day Cyclone Formation Chance: ✖ < 40%   ✖ 40-60%   ✖ > 60%
Tropical or Sub-Tropical Cyclone: ⭕ Depression   🌀 Storm   🌀 Hurricane
⊗ Post-Tropical Cyclone   ✕ Remnants

WFO San Juan

Module 1: Pre-Storm

What should be considered when interpreting the Potential Tropical Cyclone Forecasts?

- It is issued only for systems threatening land within the watch/warning time period.
- Earlier NHC advisories for systems that pose a long-range threat to the United States, or other land areas.
- Forecasts are likely to have greater uncertainty!

Model Guidance forecast track (Internal)
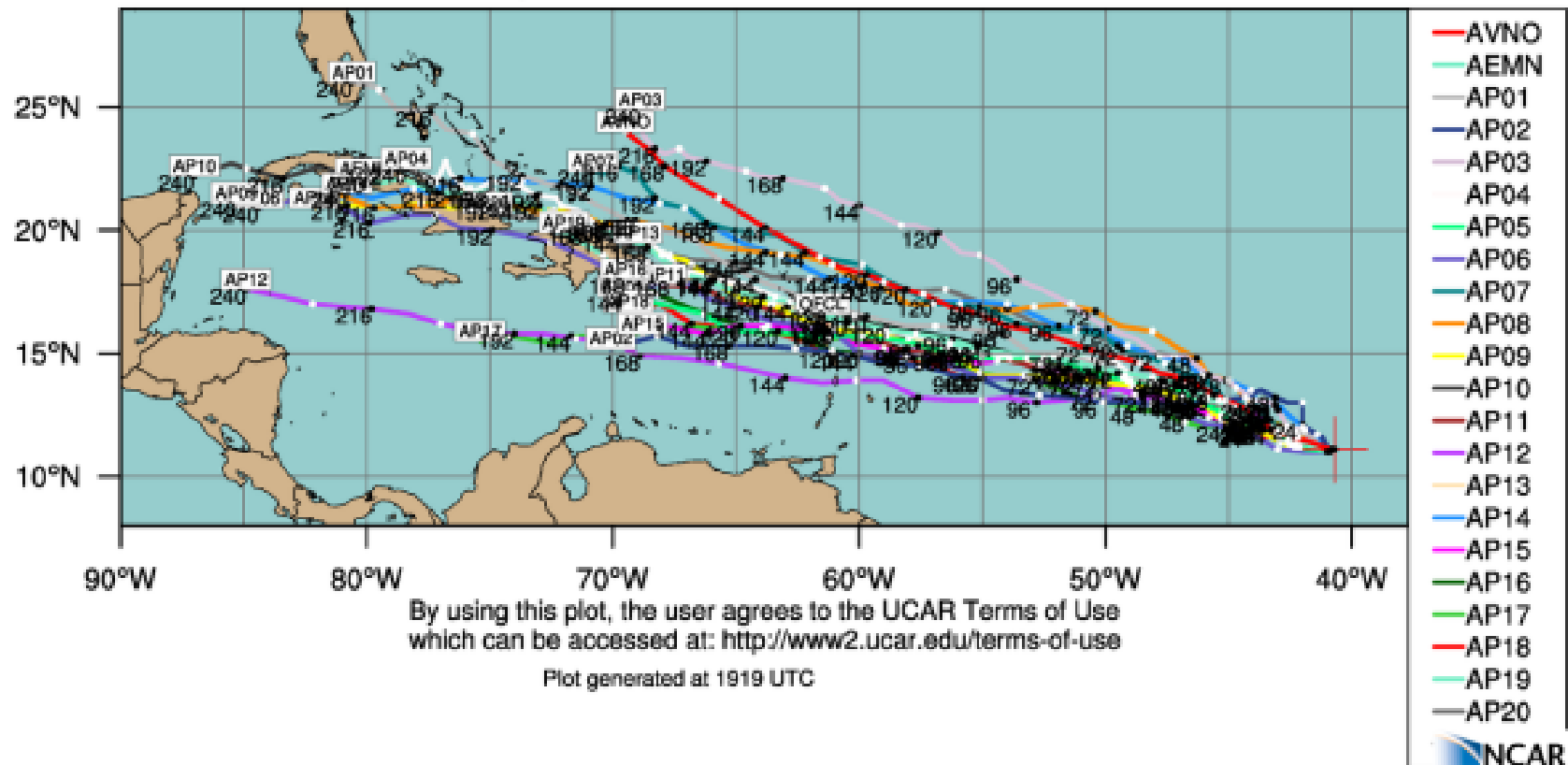
Model Guidance intensity forecast (Internal)

Levi Cowan - tropicaltidbits.com
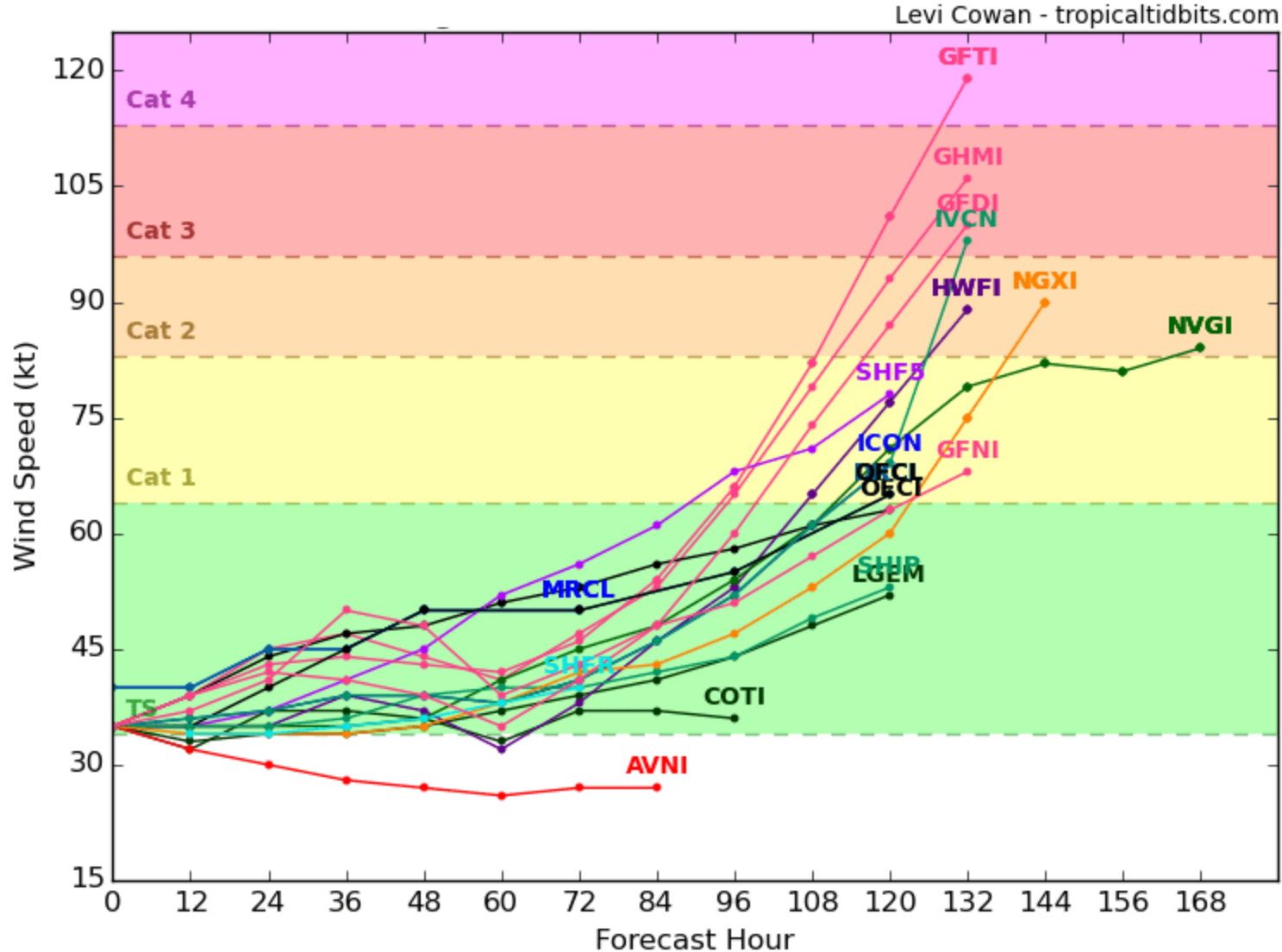
Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.
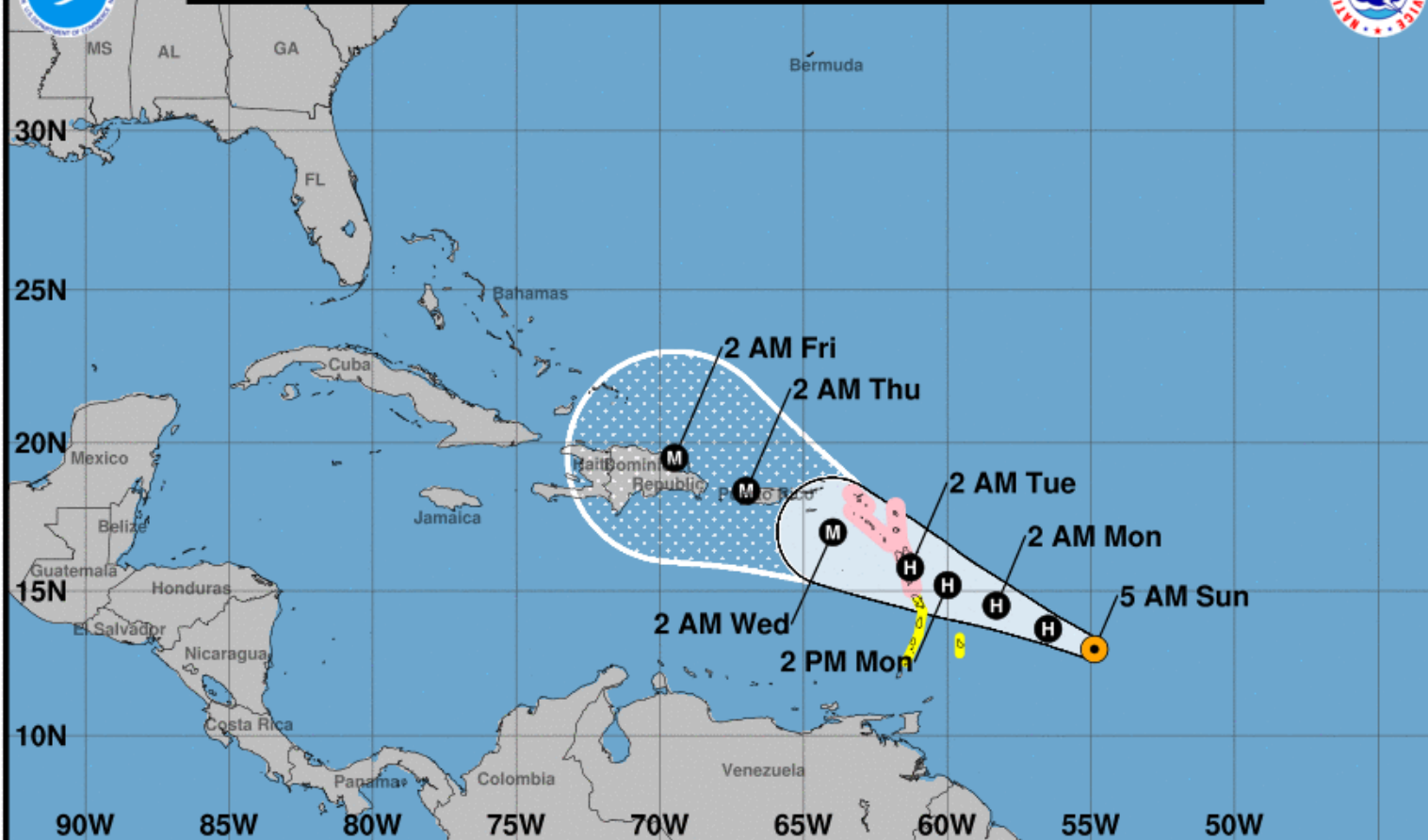
Tropical Storm Maria
Sunday September 17, 2017
5 AM AST Advisory 4
NWS National Hurricane Center

Current information: ◉
Center location 13.0 N 54.9 W
Maximum sustained wind 65 mph
Movement WNW at 15 mph

Forecast positions:
● Tropical Cyclone   ○ Post/Potential TC
Sustained winds: D < 39 mph
S 39-73 mph H 74-110 mph M > 110 mph

Potential track area:
⬡ Day 1-3   ⬡ Day 4-5

Watches:
🟥 Hurricane   🟨 Trop Storm

Warnings:
🟥 Hurricane   🟦 Trop Storm

WFO San Juan

Most Likely Arrival Time of Tropical-Storm-Force Winds

All Times AST

Tropical Storm Maria
Sun. Sep. 17, 2017 5 am AST
Advisory 4

Storm Location & Wind Speed (knots)
○ <34   ◐ 34-63   ◕ ≥64

Five-day chance of receiving sustained 34+ knot (39+ mph) winds
5 10 20 30 40 50 60 70 80 90 100 %
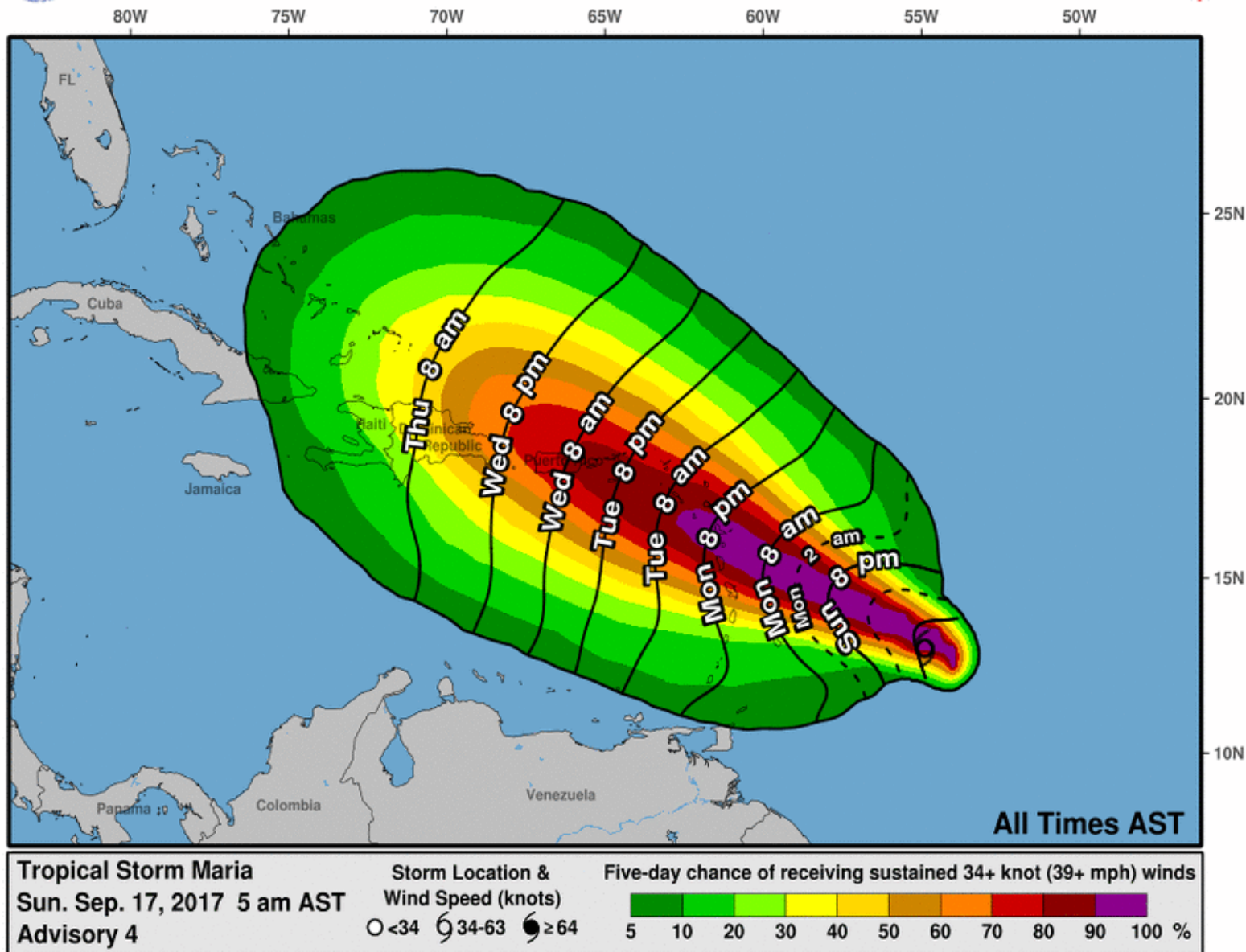
WFO San Juan

Module 1: Pre-Storm

What storm surge product should be used for planning purpose?

- MOMs- Maximum of MEOWs
  - Used in planning to design evacuation zones and operationally when uncertainty is high

- MEOWs - Maximum Envelope of Water
  - Used operationally when you can narrow down to specific scenarios

https://arcg.is/1jHzP

https://arcg.is/1jHzP

Module 1: Pre-Storm

What are the typical NHC track errors?

- Average NHC track errors increase by about 35 to 40 nautical miles per day.
  - 2-day error ~ 75 n mi   - 3-day error ~ 110 n mi
  - 4- day error ~ 160 n mi   - 5-day error ~ 220 n mi
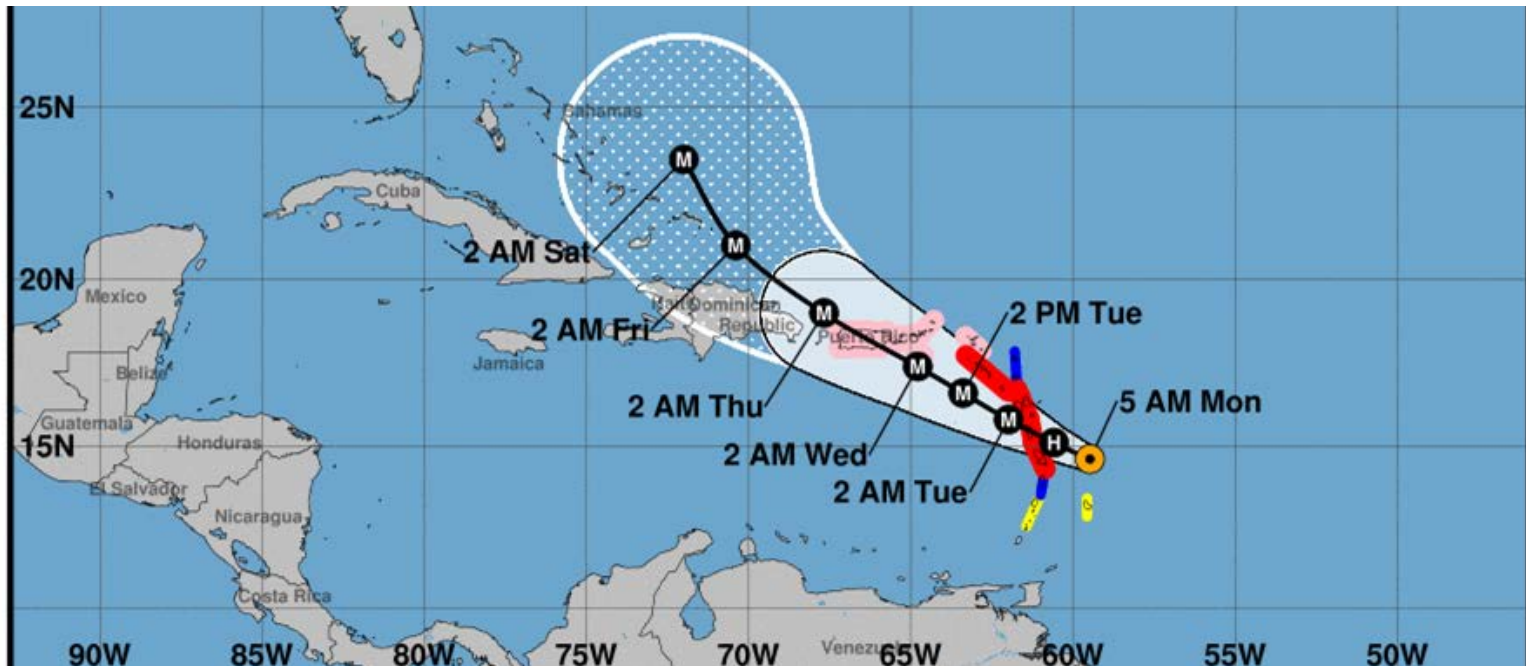
Module 2: Close to Landfall

How can you determine when will preparation should be rushed to finished based on the arrival of tropical storm force winds?

- Earliest Time of Arrival Graphic
  - Time in which individuals can safely assume that they will have to prepare for tropical-storm force winds.

Earliest Reasonable Arrival Time of Tropical-Storm-Force Winds

Hurricane Maria
Mon. Sep. 18, 2017 11 pm AST
Advisory 12

Storm Location & Wind Speed (knots)
○ <34 ◖ 34-63 ◕ ≥64

Five-day chance of receiving sustained 34+ knot (39+ mph) winds
5 10 20 30 40 50 60 70 80 90 100 %

All Times AST
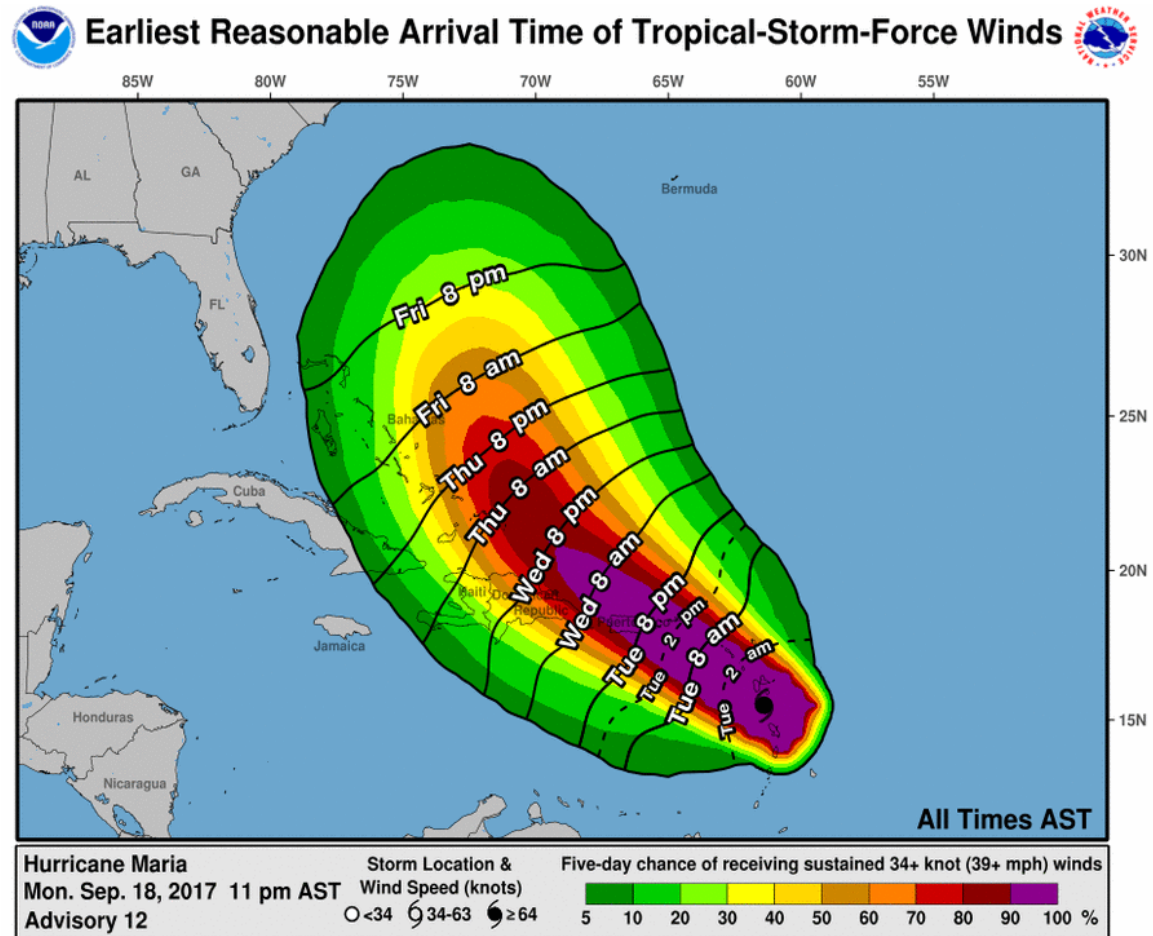
Module 2: Close to Landfall

What information provide the **Most Likely Time of Arrival Graphic**?

- Messaging Concept:
  - The expected, or most-likely time for the onset of tropical-storm force winds.
  - Individuals may have this much time, but shouldn't plan on it.

Most Likely Arrival Time of Tropical-Storm-Force Winds

All Times AST

Hurricane Maria
Mon. Sep. 18, 2017 11 pm AST
Advisory 12

Storm Location & Wind Speed (knots)
○ <34 ◔ 34-63 ● ≥64

Five-day chance of receiving sustained 34+ knot (39+ mph) winds
5 10 20 30 40 50 60 70 80 90 100 %
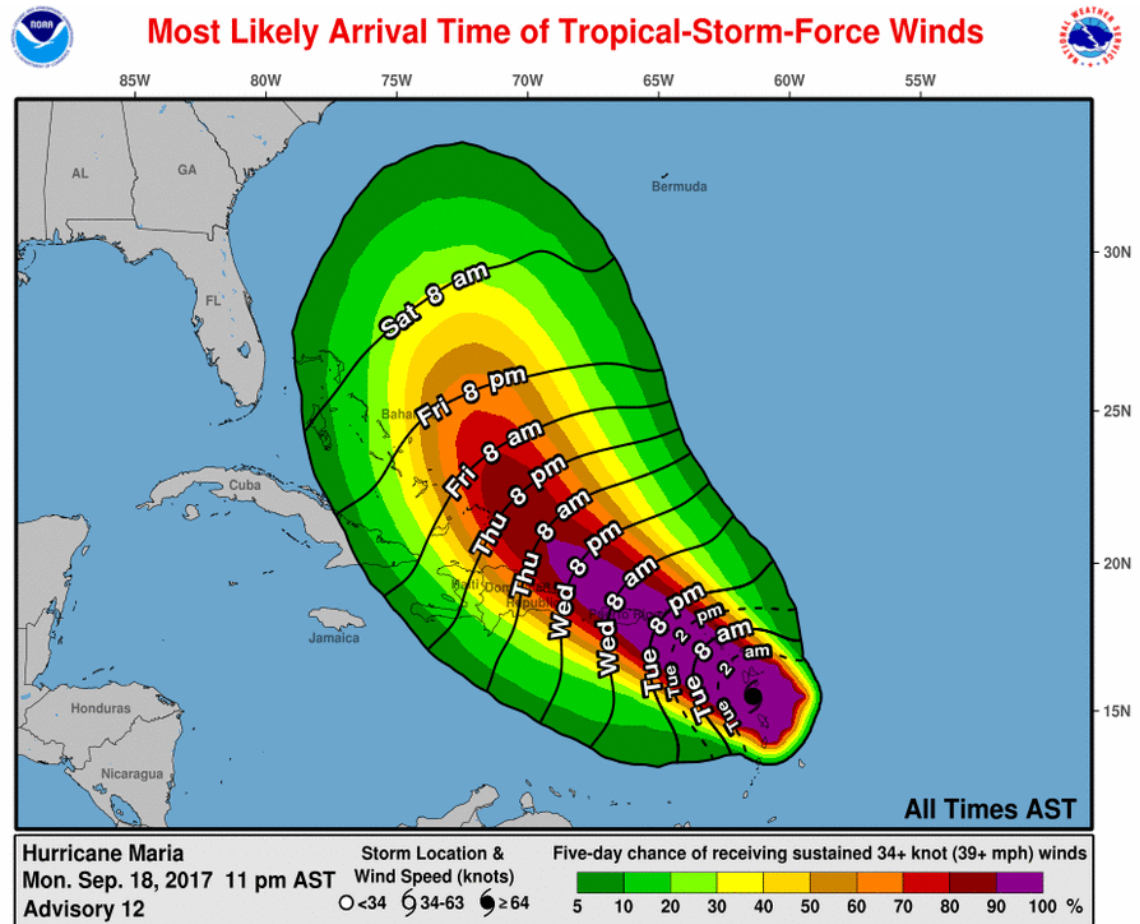
Module 2: Close to Landfall

What is the difference between a hurricane watch and a warning?

- A warning means that hurricane conditions are <mark>expected</mark> whereas a watch means that conditions are <mark>possible</mark>.

  - A **Hurricane Watch** means that hurricane conditions (sustained winds of 74 mph or higher) are possible within the specified area. A **hurricane watch is issued 48 hours in advance** of the anticipated onset of tropical-storm-force winds in an area.

  - **Hurricane warnings** indicate that hurricane conditions (sustained winds of 74 mph or higher) are expected somewhere within the specified area. **The hurricane warning is issued 36 hours in advance** of the anticipated onset of tropical-storm-force winds to allow for important preparation.

Module 2: Close to Landfall

Which product provide a good overview of the overall tropical impacts situation?

- **Hurricane Local Statement (HLS):**
  - Good overview of the overall tropical situation in a given CWA
  - Provides a summary of the worst impacts to plan for with areal descriptions

What It Does Not Represent.

- It contains no specific meteorological or threat information
- It is not detailed for decision makers

HLS

HURRICANE WILMA LOCAL STATEMENT ADVISORY NUMBER 32
NATIONAL WEATHER SERVICE MIAMI FL AL242005
533 AM EDT SUN OCT 23 2005

THIS PRODUCT COVERS SOUTH FLORIDA

**EXTENSIVE TO DEVASTATING DAMAGE AND LIFE-THREATENING CONDITIONS EXPECTED
AS HURRICANE WILMA MOVES NORTHEAST ACROSS SOUTH FLORIDA**

NEW INFORMATION
....

* CHANGES TO WATCHES AND WARNINGS:
  - A HURRICANE WATCH HAS BEEN UPGRADED TO A HURRICANE WARNING FOR
    GLADES...HENDRY...PALM BEACH...COLLIER...BROWARD...MIAMI-DADE
    AND MAINLAND MONROE COUNTIES

* CURRENT WATCHES AND WARNINGS:
  - A HURRICANE WARNING IS IN EFFECT FOR GLADES...HENDRY...PALM
    BEACH...COLLIER...BROWARD...MIAMI-DADE AND MAINLAND MONROE
    COUNTIES

* STORM INFORMATION:
  - ABOUT 480 MILES WEST-SOUTHWEST OF MIAMI FL OR ABOUT 410 MILES
    SOUTHWEST OF NAPLES FL
  - 22.1N 86.6W
  - STORM INTENSITY 100 MPH
  - MOVING NORTH OR 360 DEGREES AT 3 MPH

SITUATION OVERVIEW
....

EXTREMELY DANGEROUS HURRICANE WILMA IS FORECAST TO IMPACT SOUTH
FLORIDA BEGINNING THIS EVENING. THE MAIN CONCERN IS FOR LIFE-
THREATENING INUNDATION IN SURGE-PRONE AREAS OF COLLIER AND MAINLAND
MONROE COUNTIES WHERE THERE IS A SUBSTANTIAL RISK OF DEVASTATING
IMPACTS SOMETIME BETWEEN EARLY MONDAY MORNING AND MONDAY EVENING.
ADDITIONALLY, THERE IS A RISK FOR DEVASTATING DAMAGE FROM WIND
ACROSS MAINLAND SOUTH FLORIDA PARTICULARLY DURING DAYLIGHT HOURS
MONDAY AS WILMA CROSSES THE PENINSULA.

THERE ARE ALSO CONCERNS WITH SIGNIFICANT IMPACTS FROM FLOODING
RAINS AS THE HURRICANE MOVES ACROSS THE AREA LATE SUNDAY AND MONDAY.

ISOLATED TO SCATTERED TORNADOES CAPABLE OF INFLICTING LIMITED TO
LOCALLY SIGNIFICANT DAMAGE ARE ALSO POSSIBLE STARTING THIS AFTERNOON
AS OUTER RAIN BANDS BEGIN TO IMPACT SOUTH FLORIDA. AS YOU WORK
OUTSIDE COMPLETING YOUR PREPARATIONS, STAY TUNED TO THE LATEST IN
FORMATION IN CASE TORNADO WARNINGS BECOME NECESSARY.

SEVERAL COUNTIES HAVE MANDATORY EVACUATION ORDERS IN PLACE. CHECK WITH
YOUR LOCAL COUNTY OFFICIALS FOR ORDERS WHICH MAY AFFECT YOU.

Header
New Information

```
WTCA82 TJSJ 152332
HLSSJU
PRZ001>013-VIZ001-002-160745-

HURRICANE HUGO LOCAL STATEMENT ADVISORY NUMBER 20
NATIONAL WEATHER SERVICE SAN JUAN PR   AL111989
732 PM AST FRI SEP 15 1989

...HURRICANE WATCH IN EFFECT FOR PUERTO RICO AND THE U.S. VIRGIN ISLANDS...

NEW INFORMATION
---------------

* CHANGES TO WATCHES AND WARNINGS:
    - A HURRICANE WATCH HAS BEEN ISSUED FOR PUERTO RICO AND THE U.S. VIRGIN ISLANDS.

* CURRENT WATCHES AND WARNINGS:
    - A HURRICANE WATCH IS IN EFFECT FOR PUERTO RICO AND THE U.S. VIRGIN ISLANDS.

* STORM INFORMATION:
    - ABOUT 740 MILES EAST-SOUTHEAST OF SAN JUAN PR OR ABOUT 670
      MILES EAST-SOUTHEAST OF SAINT THOMAS VI
    - 14.8N 55.5W
    - STORM INTENSITY 150 MPH
    - MOVEMENT WEST-NORTHWEST OR 285 DEGREES AT 21 MPH
```

Potential Impacts

POTENTIAL IMPACTS
----

* WIND:
PREPARE FOR LIFE-THREATENING WIND HAVING POSSIBLE DEVASTATING IMPACTS ACROSS PUERTO RICO AND THE US VIRGIN ISLANDS. POTENTIAL IMPACTS INCLUDE:
- STRUCTURAL DAMAGE TO STURDY BUILDINGS, SOME WITH COMPLETE ROOF AND WALL FAILURES. COMPLETE DESTRUCTION OF MOBILE HOMES. DAMAGE GREATLY ACCENTUATED BY LARGE AIRBORNE PROJECTILES. LOCATIONS MAY BE UNINHABITABLE FOR WEEKS OR MONTHS.
- NUMEROUS LARGE TREES SNAPPED OR UPROOTED ALONG WITH FENCES AND ROADWAY SIGNS BLOWN OVER.
- MANY ROADS IMPASSABLE FROM LARGE DEBRIS, AND MORE WITHIN URBAN OR HEAVILY WOODED PLACES. MANY BRIDGES, CAUSEWAYS, AND ACCESS ROUTES IMPASSABLE.
- WIDESPREAD POWER AND COMMUNICATIONS OUTAGES.

* FLOODING RAIN:
PREPARE FOR DANGEROUS RAINFALL FLOODING HAVING POSSIBLE SIGNIFICANT IMPACTS ACROSS PUERTO RICO AND THE US VIRGIN ISLANDS. POTENTIAL IMPACTS INCLUDE:
- MODERATE RAINFALL FLOODING MAY PROMPT SEVERAL EVACUATIONS AND RESCUES.
- RIVERS AND TRIBUTARIES MAY QUICKLY BECOME SWOLLEN WITH SWIFTER CURRENTS AND OVERSPILL THEIR BANKS IN A FEW PLACES, ESPECIALLY IN USUALLY VULNERABLE SPOTS. SMALL STREAMS, CREEKS, CANALS, ARROYOS, AND DITCHES OVERFLOW.
- FLOOD WATERS CAN ENTER SOME STRUCTURES OR WEAKEN FOUNDATIONS. SEVERAL PLACES MAY EXPERIENCE EXPANDED AREAS OF RAPID INUNDATION AT UNDERPASSES, LOW-LYING SPOTS, AND POOR DRAINAGE AREAS. SOME STREETS AND PARKING LOTS TAKE ON MOVING WATER AS STORM DRAINS AND RETENTION PONDS OVERFLOW. DRIVING CONDITIONS BECOME HAZARDOUS. SOME ROAD AND BRIDGE CLOSURES.

Potential Impacts

* SURGE: PREPARE FOR LOCALLY HAZARDOUS SURGE HAVING POSSIBLE
  LIMITED IMPACTS ACROSS PUERTO RICO AND THE US VIRGIN ISLANDS.
  POTENTIAL IMPACTS IN THIS AREA INCLUDE:

    - LOCALIZED INUNDATION WITH STORM SURGE FLOODING MAINLY ALONG
        IMMEDIATE SHORELINES AND IN LOW-LYING SPOTS, OR IN AREAS FARTHER
      INLAND NEAR WHERE HIGHER SURGE WATERS MOVE ASHORE.
    - SECTIONS OF NEAR-SHORE ROADS AND PARKING LOTS BECOME OVERSPREAD
      WITH SURGE WATER. DRIVING CONDITIONS DANGEROUS IN PLACES WHERE
      SURGE WATER COVERS THE ROAD.
    - MODERATE BEACH EROSION. HEAVY SURF ALSO BREACHING DUNES, MAINLY
      IN USUALLY VULNERABLE LOCATIONS. STRONG RIP CURRENTS.
    - MINOR TO LOCALLY MODERATE DAMAGE TO MARINAS, DOCKS, BOARDWALKS,
      AND PIERS. A FEW SMALL CRAFT BROKEN AWAY FROM MOORINGS.

* TORNADOES:
PREPARE FOR A TORNADO EVENT HAVING POSSIBLE LIMITED IMPACTS ACROSS
PUERTO RICO AND THE US VIRGIN ISLANDS. POTENTIAL IMPACTS INCLUDE:
    - THE OCCURRENCE OF ISOLATED TORNADOES CAN HINDER THE EXECUTION
      OF EMERGENCY PLANS DURING TROPICAL EVENTS.
    - A FEW PLACES MAY EXPERIENCE TORNADO DAMAGE, ALONG WITH POWER
      AND COMMUNICATIONS DISRUPTIONS.
    - LOCATIONS COULD REALIZE ROOFS PEELED OFF BUILDINGS, CHIMNEYS
      TOPPLED, MOBILE HOMES PUSHED OFF FOUNDATIONS OR OVERTURNED,
      LARGE TREE TOPS AND BRANCHES SNAPPED OFF, SHALLOW-ROOTED TREES
      KNOCKED OVER, MOVING VEHICLES BLOWN OFF ROADS, AND SMALL BOATS
      PULLED FROM MOORINGS.

National Weather Service San Juan

Precautionary Statements

PRECAUTIONARY/PREPAREDNESS ACTIONS
----

* EVACUATIONS:

IF YOU ARE EXCEPTIONALLY VULNERABLE TO WIND OR WATER HAZARDS FROM
TROPICAL SYSTEMS, CONSIDER VOLUNTARY EVACUATION, ESPECIALLY IF
BEING OFFICIALLY RECOMMENDED. RELOCATE TO A PREDETERMINED SHELTER
OR SAFE DESTINATION.

* OTHER PREPAREDNESS INFORMATION:

NOW IS THE TIME TO CHECK YOUR EMERGENCY
PLAN AND TAKE NECESSARY ACTIONS TO SECURE YOUR HOME OR BUSINESS.
DELIBERATE EFFORTS SHOULD BE UNDERWAY TO PROTECT LIFE AND
PROPERTY. ENSURE THAT YOUR EMERGENCY SUPPLIES KIT IS STOCKED AND
READY.

WHEN MAKING SAFETY AND PREPAREDNESS DECISIONS, DO NOT FOCUS ON THE
EXACT FORECAST TRACK AS THERE ARE INHERENT FORECAST UNCERTAINTIES
WHICH MUST BE TAKEN INTO ACCOUNT.

IF YOU LIVE IN A PLACE THAT IS PARTICULARLY VULNERABLE TO HIGH WIND,
SUCH AS A MOBILE HOME, AN UPPER FLOOR OF A HIGH RISE BUILDING, OR ON
A BOAT, PLAN TO MOVE TO SAFE SHELTER. TAKE ENOUGH SUPPLIES FOR YOU
AND YOUR FAMILY FOR SEVERAL DAYS.

VISITORS TO THE AREA SHOULD BECOME FAMILIAR WITH NEARBY
SURROUNDINGS. IF YOU ARE A VISITOR, KNOW THE NAME OF THE COUNTY OR
PARISH IN WHICH YOU ARE LOCATED AND WHERE IT IS RELATIVE TO
CURRENT WATCHES AND WARNINGS. IF STAYING AT A HOTEL, ASK THE
MANAGEMENT STAFF ABOUT THEIR ONSITE DISASTER PLAN. LISTEN FOR
EVACUATION ORDERS, ESPECIALLY PERTAINING TO AREA VISITORS.

CLOSELY MONITOR NOAA WEATHER RADIO OR OTHER LOCAL NEWS OUTLETS FOR
OFFICIAL STORM INFORMATION. LISTEN FOR POSSIBLE CHANGES TO THE
FORECAST.

* ADDITIONAL SOURCES OF INFORMATION:
- FOR INFORMATION ON APPROPRIATE PREPARATIONS SEE READY.GOV
- FOR INFORMATION ON CREATING AN EMERGENCY PLAN SEE GETAGAMEPLAN.ORG
- FOR ADDITIONAL DISASTER PREPAREDNESS INFORMATION SEE REDCROSS.ORG

NEXT UPDATE

THE NEXT LOCAL STATEMENT WILL BE ISSUED BY THE NATIONAL WEATHER
SERVICE IN SAN JUAN PR AROUND 8 PM AST, OR SOONER IF CONDITIONS
WARRANT.

National Weather Service San Juan

Hurricane Threat and Impacts
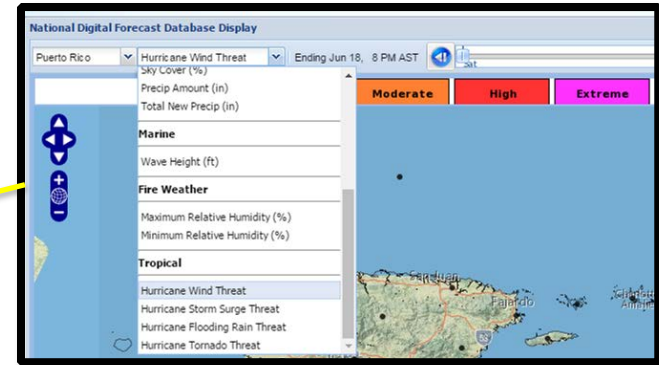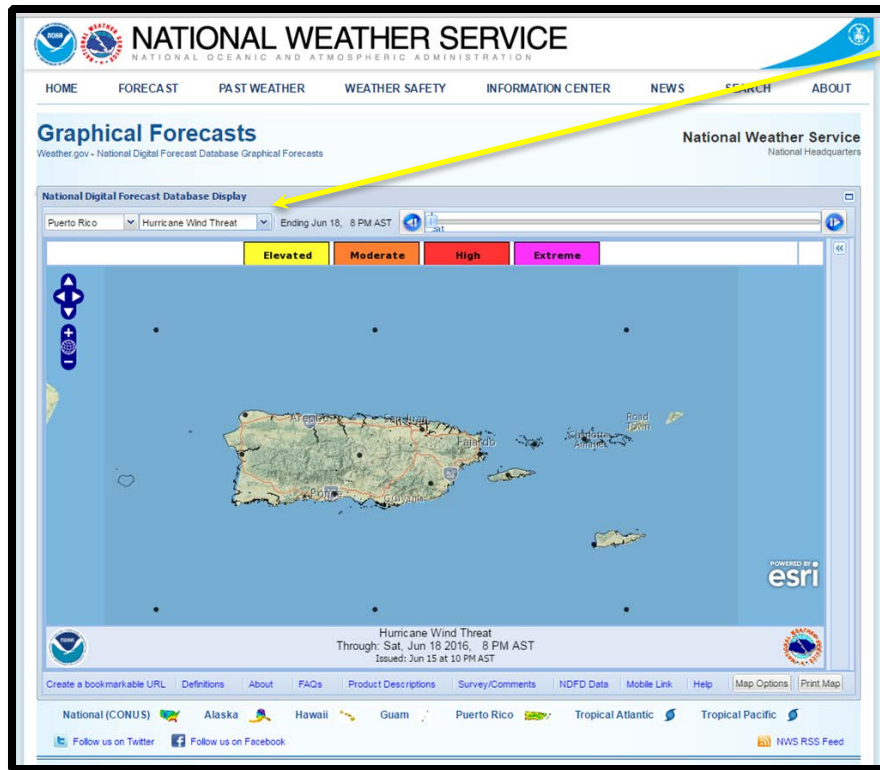
Consist of four elements:

- Wind

- Storm surge

- Flooding rain

- Tornado

Provide the **reasonable worst case scenario**, taking into account the forecast magnitude of the hazard, along with the associated uncertainty of the forecast.

Grids are available at:

- http://digital.weather.gov/

Module 3: Landfall

When is issued an Extreme Wind Warning (EWW)?

- It is only issued in association with major hurricanes.
- The criteria for an EWW is sustained surface winds of 115 mph or greater.
- The EWW is intended to alert the public to prepare for potentially life-threatening conditions.

```
BULLETIN - EAS ACTIVATION REQUESTED
Extreme Wind Warning
National Weather Service San Juan PR
538 AM AST WED SEP 20 2017

The National Weather Service in San Juan has issued a

* Extreme Wind Warning for...
  Trujillo Alto Municipality in Puerto Rico...
  Rio Grande Municipality in Puerto Rico...
  San Juan Municipality in Puerto Rico...
  Aguas Buenas Municipality in Puerto Rico...
  Carolina Municipality in Puerto Rico...
  Canovanas Municipality in Puerto Rico...
  Guaynabo Municipality in Puerto Rico...
  Bayamon Municipality in Puerto Rico...
  Cidra Municipality in Puerto Rico...

* Until 700 AM AST

* At 533 AM AST, National Weather Service Doppler radar indicated
  extreme winds, associated with the eyewall of Major Hurricane
  Maria already moving onshore and will quickly impact Rio Grande,
  Canovanas, Aguas Buenas, Cidra and the San Juan Metro Area within
  the next hour. This is an extremely dangerous and life-threatening
  situation!

PRECAUTIONARY/PREPAREDNESS ACTIONS...

TAKE COVER NOW! Move immediately to the safe room in your shelter.
Take action now to protect your life!

The safest place to be during a major landfalling hurricane is in a
reinforced interior room away from windows. Get under a table or
other piece of sturdy furniture. Use mattresses, blankets or pillows
to cover your head and body. Remain in place through the passage of
these life-threatening conditions.
```

Extreme Wind Warning

★ Major Hurricane Irma (Category 5)
★ Three (3) warnings were issued by **WFO San Juan**
★ September 6, 2017

HURRICANE IRMA
SEPTEMBER 6, 2017
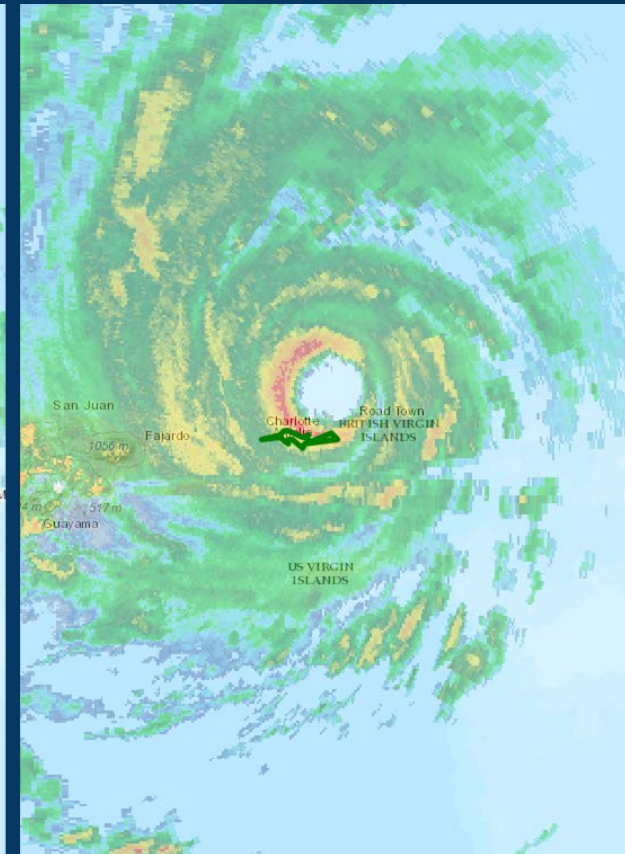
```
000
WFCA52 TJSJ 200754
EWWSJU
PRC147-201000-
/O.NEW.TJSJ.EW.W.0004.170920T0754Z-170920T1000Z/

BULLETIN - EAS ACTIVATION REQUESTED
Extreme Wind Warning
National Weather Service San Juan PR
354 AM AST WED SEP 20 2017

The National Weather Service in San Juan has issued a

* Extreme Wind Warning for...
  Vieques Municipality in Puerto Rico...

* Until 600 AM AST

* At 353 AM AST, National Weather Service Doppler radar indicated
  extreme winds, associated with the eyewall of Major Hurricane
  Maria is quickly approaching Vieques from the south. This is an
  extremely dangerous and life-threatening situation!

PRECAUTIONARY/PREPAREDNESS ACTIONS...

TAKE COVER NOW! Move immediately to the safe room in your shelter.
Take action now to protect your life!

The safest place to be during a major landfalling hurricane is in a
reinforced interior room away from windows. Get under a table or
other piece of sturdy furniture. Use mattresses, blankets or pillows
to cover your head and body. Remain in place through the passage of
these life-threatening conditions.

&&

LAT...LON 1814 6530 1815 6529 1813 6527 1813 6531
        1811 6535 1812 6534 1813 6536 1811 6538
        1811 6544 1810 6542 1811 6545 1809 6544
        1810 6546 1809 6551 1808 6552 1808 6555
        1810 6558 1812 6557 1816 6540
TIME...MOT...LOC 0753Z 000DEG 0KT 1811 6551

$$

ER/RGH
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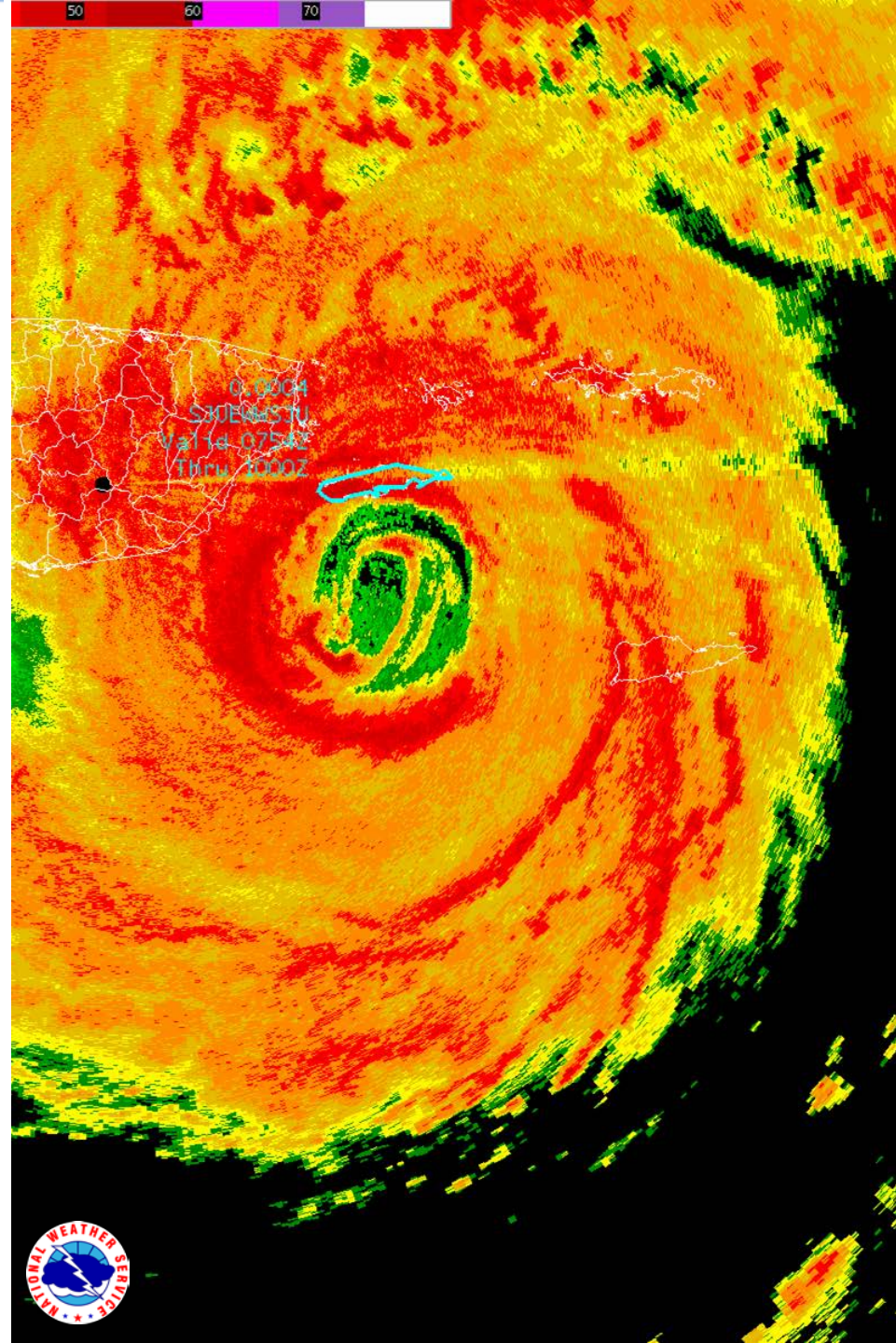
Module 3: After landfall

Which is the difference between a Flash Flood Warning and a Flash Flood Emergency?

- A **Flash Flood Warning** is issued to inform that flash flooding is in progress, imminent, or highly likely. Flash Flood Warnings are urgent messages as dangerous flooding can develop very rapidly, with a serious threat to life and/or property.

- A **Flash Flood Emergency** is an exceptionally rare life-threatening situation.

    – Total failure of a major dam.

    – Multiple swift water rescue teams have been or are being deployed in response to flash flooding of an exceptional magnitude.

    – Water has rapidly risen or will rapidly rise to levels where people who are ordinarily in safe locations during previous flash flood events are now placed in life-threatening situations.

Module 4: Post-Storm

After warning and watches expired, what products are issued?

WFO-SJU returns to normal operations. Any weather hazard is then treated on a case by case scenario.

For example:
- Flash Flood Warning
- Coastal Flood Warning
- Severe Thunderstorm Warning
- Special Weather Statements
- Hazard Weather Outlook

If required, WFO-SJU will provide IDSS briefing in order to assist the recovery process.

Sandy is about 1000 miles NW of Puerto Rico

Outer Bands of Hurricane Sandy will continue to affect parts of Puerto Rico today

1055 AM AST
Fri Oct 26 2012
National Weather Service
San Juan, PR
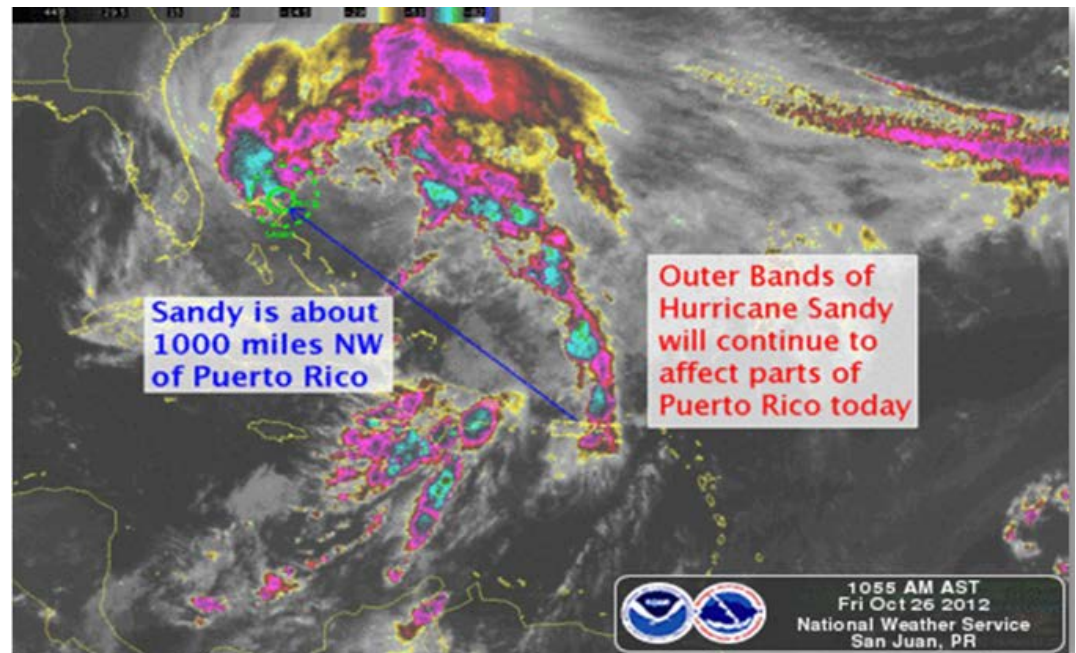
Exercise Tools

WFO Knowledge of Potential Peak Impacts

Very Long-term
Climatology/
Statistics,
Seasonal
Outlooks,
Preparedness
Talks,
MOM

Long-term
HWO, PNS, EM Briefings,
Media Interviews, Social Media,
NHC Wind Speed Probabilities
(5 days),
MOM, MEOW

Long-term
Hurricane Watch, Hurricane
Warning, HLS, TCV, EM Brief-
ings, Media Interviews,
Social Media,
NHC Wind Speed Probabilities,
Probabilistic Storm Surge,
Potential Storm Surge Flooding
Map

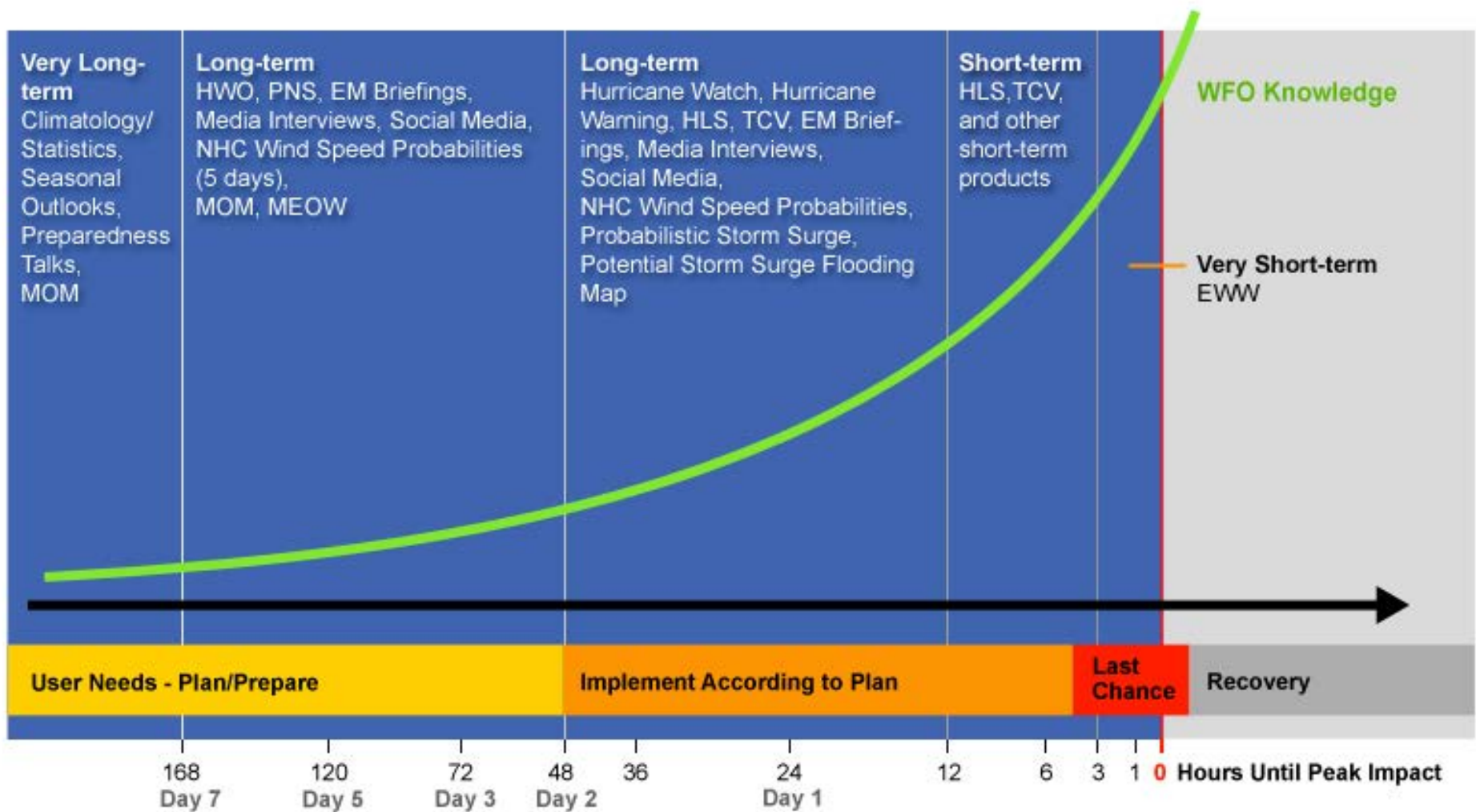**Short-term**
HLS,TCV,
and other
short-term
products

WFO Knowledge

— **Very Short-term**
EWW

User Needs - Plan/Prepare

Implement According to Plan

Last Chance

Recovery

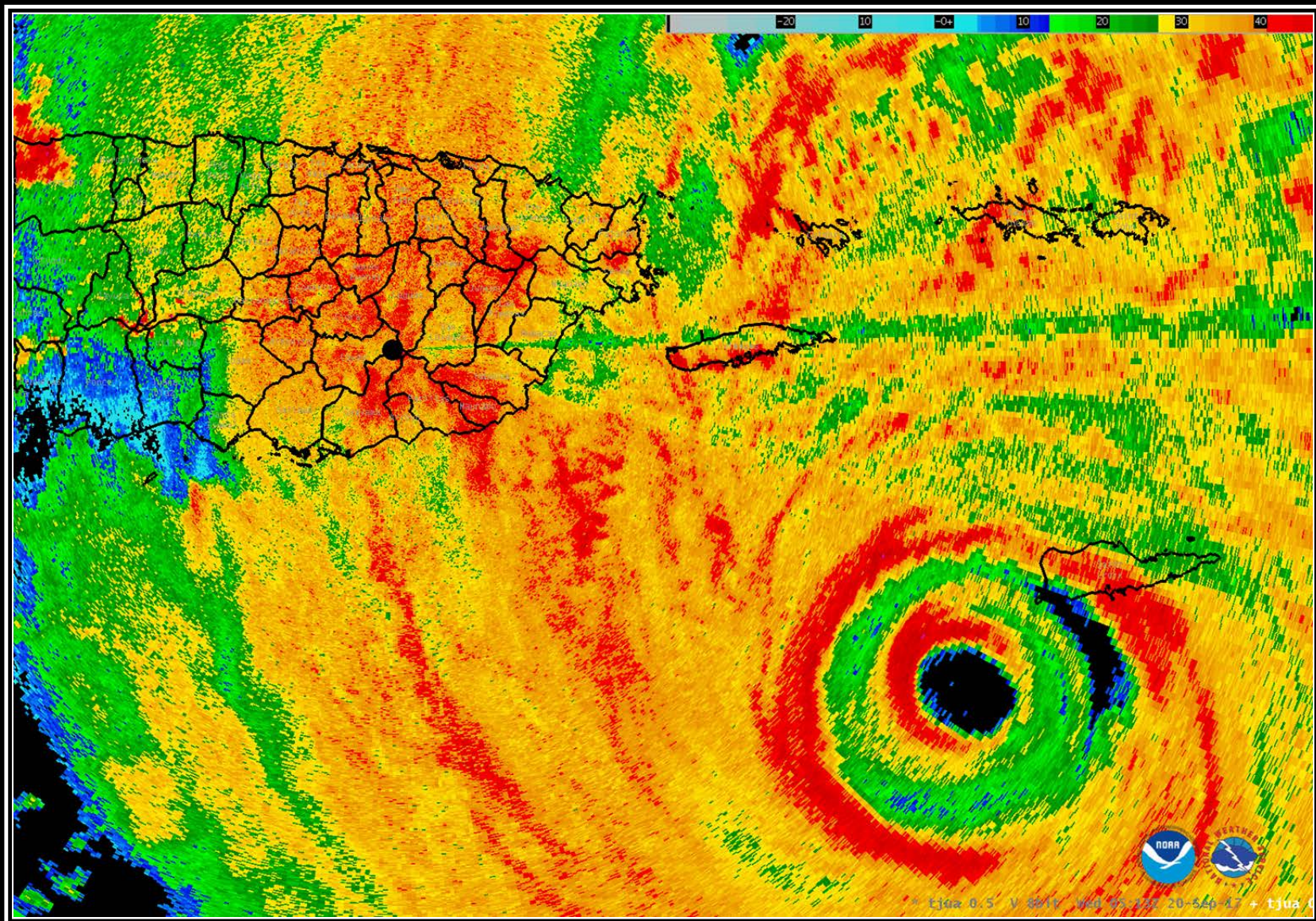| 168 | 120 | 72 | 48 | 36 | 24 | 12 | 6 | 3 | 1 | 0 | Hours Until Peak Impact |
| Day 7 | Day 5 | Day 3 | Day 2 | | Day 1 | | | | | | |

NWS/NOAA

WFO San Juan

Tropical Weather Outlook
NWS National Hurricane Center Miami FL
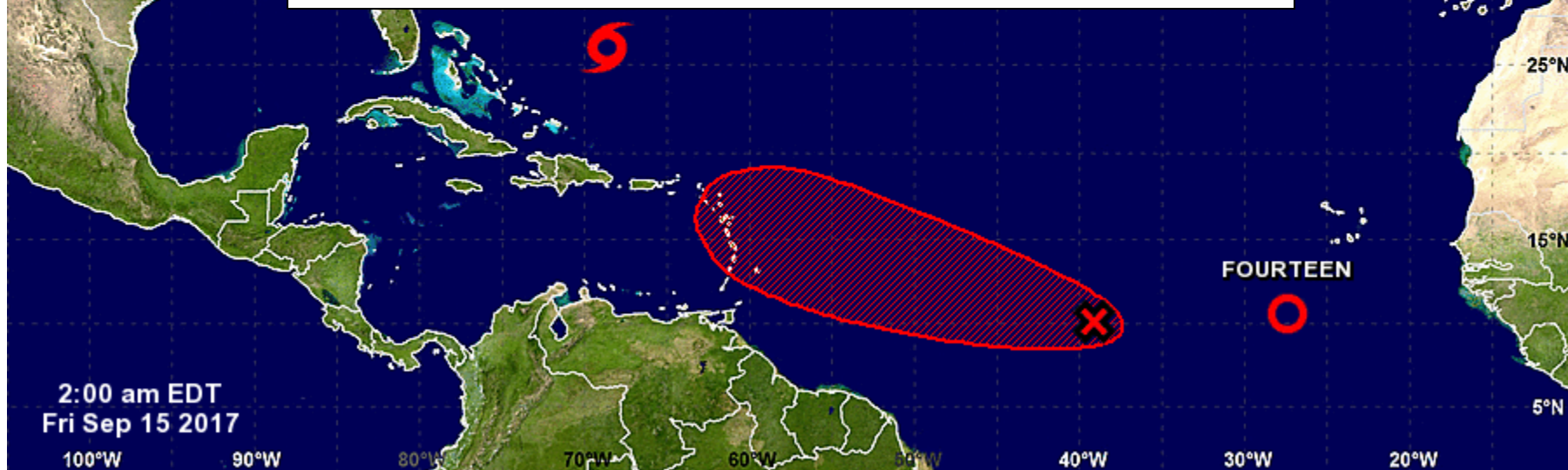200 AM EDT Fri Sep 15 2017

For the North Atlantic...Caribbean Sea and the Gulf of Mexico:

The National Hurricane Center is issuing advisories on Tropical Storm Jose, located over the southwestern Atlantic Ocean, and on newly developed Tropical Depression Fourteen, located over the eastern Atlantic Ocean.

1. A tropical wave located about 1200 miles east-southeast of the Lesser Antilles continues to produce disorganized showers and thunderstorms. Environmental conditions are expected to be conducive for gradual development, and a tropical depression is likely to form early next week. Interests in the Lesser Antilles should closely monitor the progress of this system while it moves westward to west-northwestward at about 15 mph.
* Formation chance through 48 hours...medium...40 percent.
* Formation chance through 5 days...high...80 percent.

All Disturbances

www.hurricanes.gov

FOURTEEN

2:00 am EDT
Fri Sep 15 2017

Current Disturbances and Five-Day Cyclone Formation Chance: ✖ < 40%   ✖ 40-60%   ✖ > 60%
Tropical or Sub-Tropical Cyclone: O Depression   🌀 Storm   🌀 Hurricane
⊗ Post-Tropical Cyclone   ✕ Remnants

WFO San Juan

ACTIVITY #1: Preparation

Assume that you represent the state EM Bureau and you need to provide the ***Tropical Cyclone Formation Chance*** to regional EMs.

1) Based on the latest **Tropical Weather Outlook** (TWO),
   a) Which is the formation chance through 48 hours?
   b) Which is the formation chance through 5 days?

1) What represents the hatched area?

In addition, they asked you about:

1) Which is the difference between a Tropical Storm Watch and a Tropical Storm Warning?

1) Which is the difference between a Hurricane Watch and a Hurricane Warning?

ACTIVITY #2: Preparation and Threats-
TC Watches and Warnings in effect
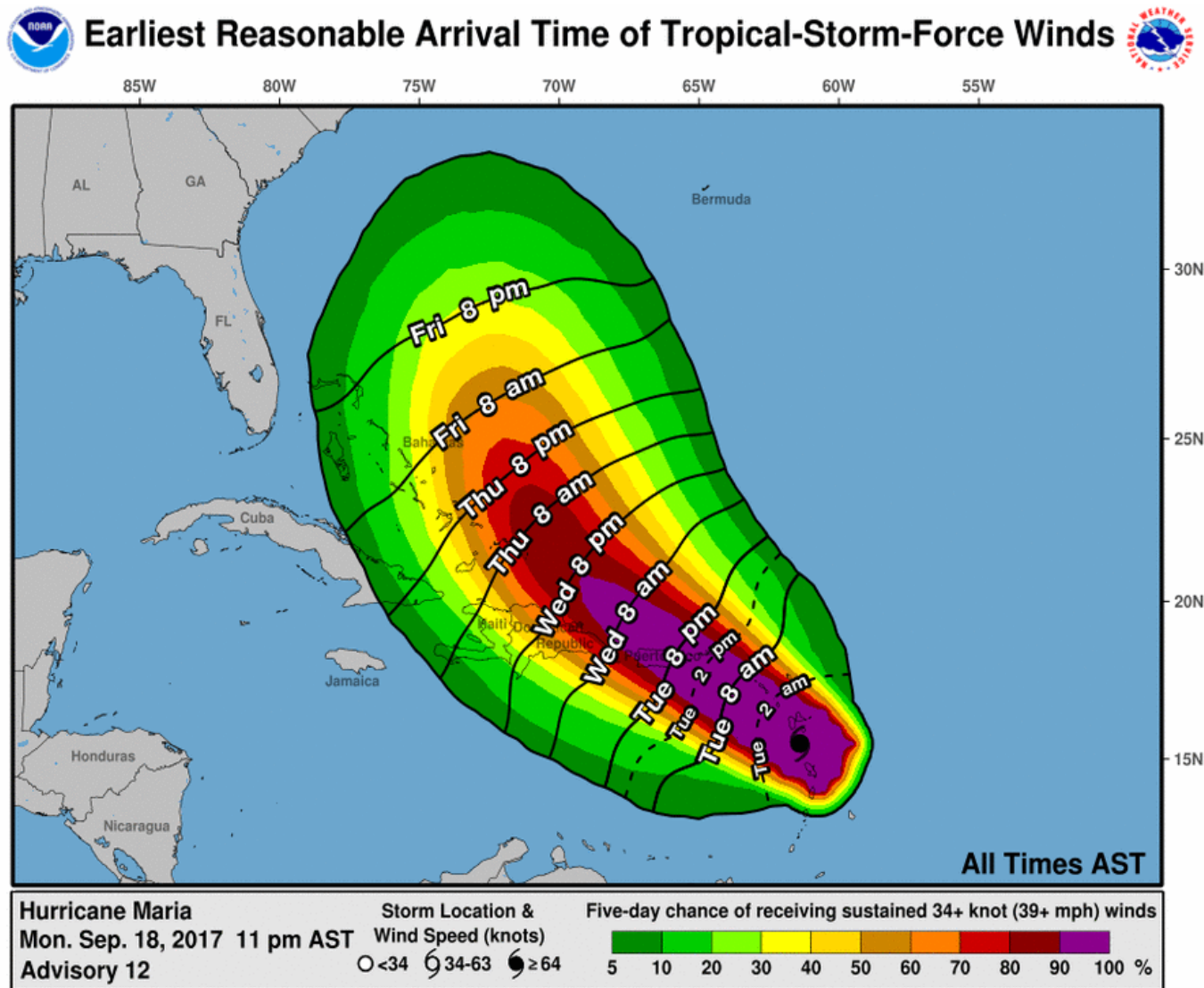
Assume that you represent the state EM Bureau and you need to provide the **earliest time of arrival** as well as the **most likely time of arrival** to regional EMs.

1) Provide the earliest time of arrival for:
   a) Saint Croix
   b) San Juan
   c) Arecibo
   d) Mayaguez
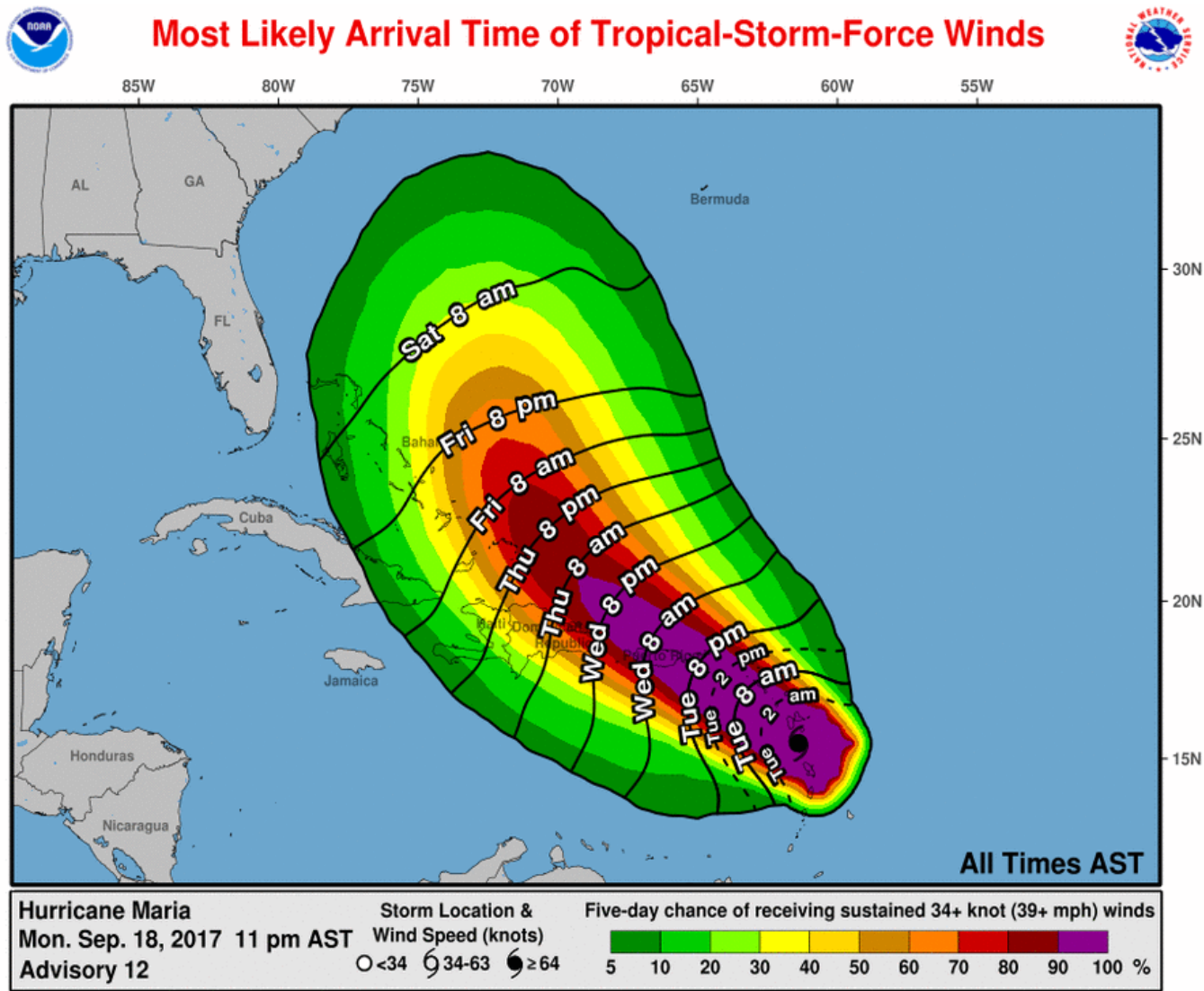
1) Provide the most likely time of arrival for:
   a) Saint Croix
   b) San Juan
   c) Arecibo
   d) Mayaguez

SCENARIO OUTLINE - Imminent

Earliest Reasonable Arrival Time of Tropical-Storm-Force Winds

Hurricane Maria
Mon. Sep. 18, 2017 11 pm AST
Advisory 12

All Times AST

WFO San Juan

SCENARIO OUTLINE - Imminent

Most Likely Arrival Time of Tropical-Storm-Force Winds

ACTIVITY #2: Preparation and Threats-
TC Watches and Warnings in effect

Assume that you represent the state EM Bureau and you need to provide the following information to regional EMs.

1) Based on the latest **Hurricane Local Statement** (HLS)
   a) Which are the current **Watches** and **Warnings**?
   b) Which are the **Potential Impacts**?
   c) When will be the **next** forecast update?

ACTIVITY #2: Preparation and Threats-
TC Watches and Warnings in effect

Assume that you represent the state EM Bureau and you need to provide the following information to regional EMs. Now you are focused over <u>southeast Puerto Rico</u>.

1) Based on the latest **Tropical Cyclone Watch/Warning** (TCV)
    a) Provide the ***Threat Level*** (None, Elevated, Moderate, High, Extreme) for
        i)   Winds
        ii) Storm Surge
        iii) Flooding Rain
        iv) Tornado

ACTIVITY #2: Preparation and Threats- TC Watches and Warnings in effect

Assume that you represent the state EM Bureau and you need to provide the following information to regional EMs. Now you are focused over <u>San Juan and Vicinity</u>.

1) Based on the latest **Tropical Cyclone Watch/Warning** (TCV)
   a) Provide the ***Potential Impacts*** for
      i) Winds
      ii) Storm Surge
      iii) Flooding Rain
      iv) Tornado

ACTIVITY #2: Preparation and Threats-
TC Watches and Warnings in effect

Assume that you represent the state EM Bureau and you need to provide the following information to regional EMs. Now you are focused over <u>Saint Croix</u>.

1) Based on the latest **Tropical Cyclone Watch/Warning** (TCV), provide the following information
   a) Timing for tropical storm force winds
   b) Timing for hurricane force winds
   c) Peak wind and gust
   d) Equivalent Category

ACTIVITY #3: Risk Communication

You as EM wants to communicate threats and impacts using social media.

1) Provide an example of a social media post, including #hashtags to communicate threats and impacts.

You as EM wants to clarify which are the official forecast sources.

1) Provide an example of a social media post in order to identify the official forecast sources.

ACTIVITY #4: Ongoing Threats-
TC Watches and Warnings in effect

Assume that you represent the state EM Bureau and you need to clarify the following information to regional EMs.

1) Which is the difference between a **Flash Flood Warning** and a **Flash Flood Emergency**?

1) What means an **Extreme Wind Warning**?

SCENARIO OUTLINE - Post Storm

Flood Threat
Valid from 6 AM AST Nov 08, 2018 to 6 PM AST Nov 08, 2018
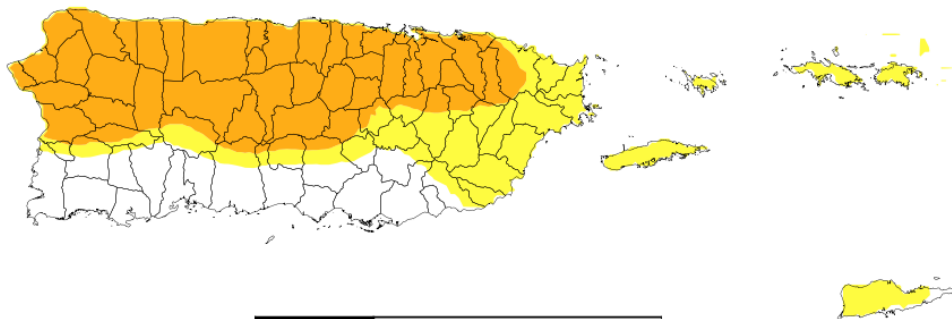
Threat	Flood
SLIGHT	Ponding of water in roads and poorly drained areas.
MODERATE	Urban and small stream flooding.
HIGH	Widespread flooding possible, having major impact on structures & road closures.
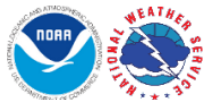
National Weather Service
San Juan, PR
11/08/2018 03:49 AST

Follow Us:
weather.gov/sju
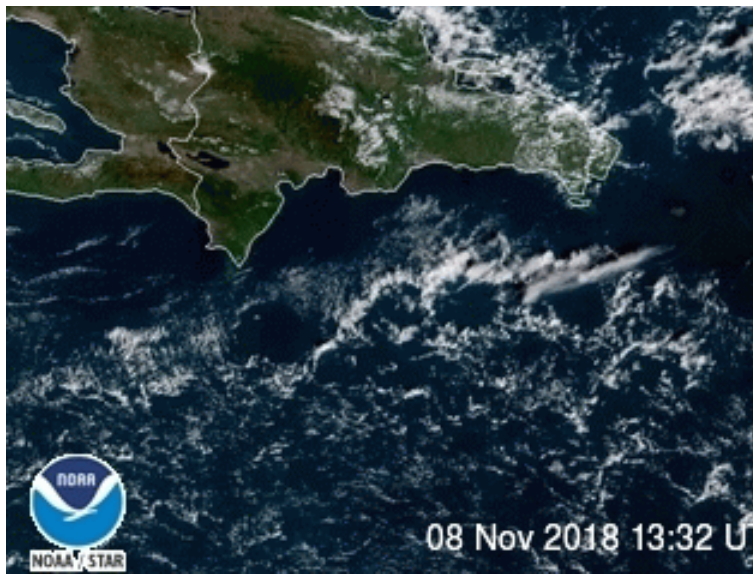
08 Nov 2018 13:32 UTC GOES-East GEOCOLOR

Click a location below for detailed forecast.
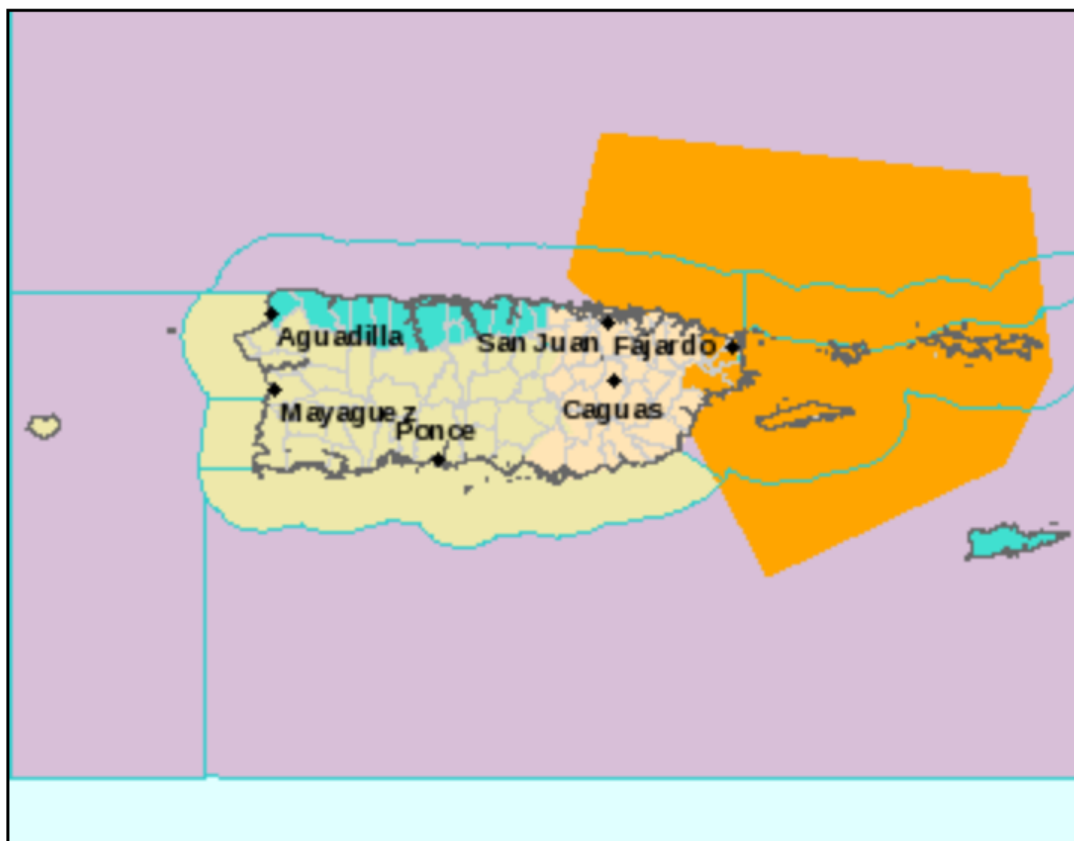
Last Map Update: Sat, Nov. 3, 2018 at 8:49:38 pm AST

Watches,
Warnings &
Advisories

Zoom
Out

Severe Thunderstorm
Warning

Special Marine
Warning

Small Craft Advisory

Rip Current Statement

Special Weather
Statement

Marine Weather
Statement

Hazardous Weather
Outlook

Click a location below for detailed forecast.

Watches, Warnings & Advisories

Zoom Out
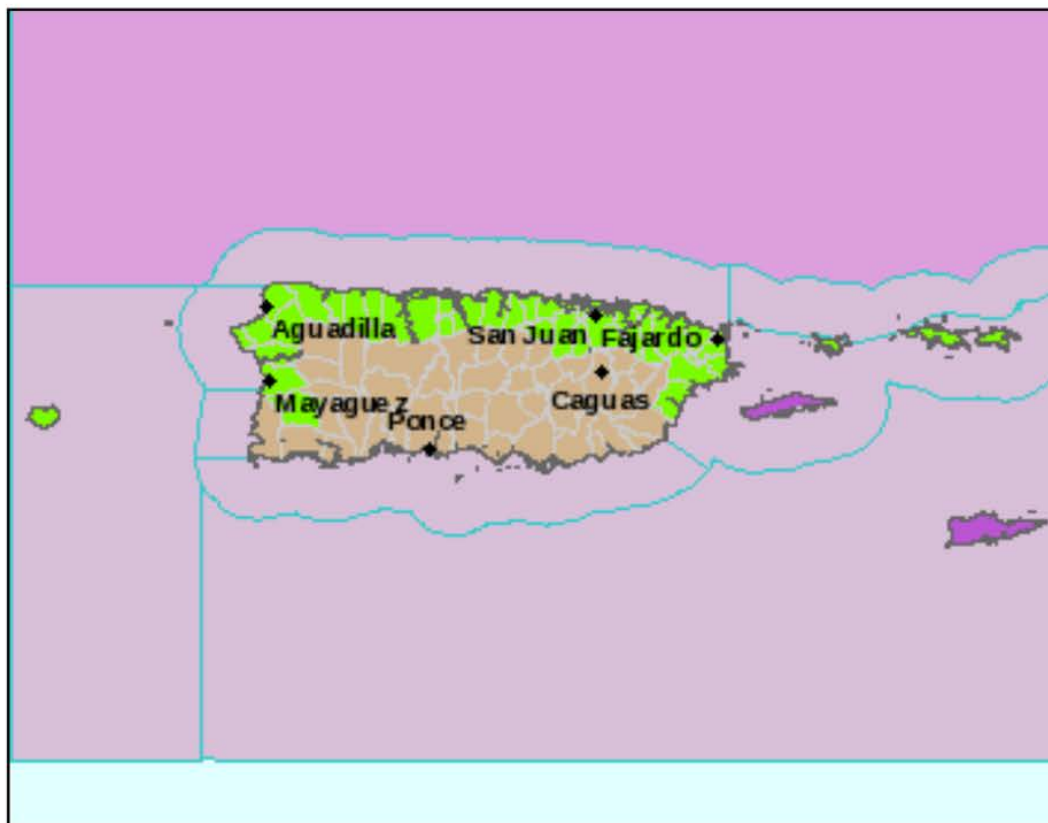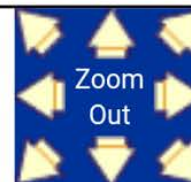
Advisory	
Gale Warning	
Coastal Flood Advisory	
High Surf Advisory	
Small Craft Advisory	
Wind Advisory	
Rip Current Statement	
Hazardous Weather Outlook	
Short Term Forecast	

Last Map Update: Sat, Jan. 27, 2018 at 8:30:35 pm AST

Appendix F: Conclusions and Outcomes Notes

Challenge Category	Identified Response Challenge	Explanation/Description	Lessons Learned	Improvement(s) (Actionable Tasks)	How does approach change with respect to Tsunami vs Hurricane?	Comments	Recommendation for Implementation	Ease of Implementation (1=easy, 5=hard)	Coordination w. Partners
Communication	Ability to communicate with small communities	Lacked proper terminology to inform community	Post emergency communication needs to be simple and tailored to community (municipalities)	1. Use of short wave radios (response), SAT internet, power (generators). 2. Be aware of langue and culture needs. Develop focus groups to identify effective language/terminology, science communication training for personnel in agencies. 3. Outreach before events, such as posting informational flyers. Take information to community, and ask for feedback on material. Ask which sources of social media are most widely used, investigate which apps are applicable to community and use contact point to distribute information. 4. Identify centralized information in public location. Map communities & identify liaisons (e.g., community leaders). 5. Verify the community leaders, and conduct pre-training at the community level. Pick central location(s)/focal point to distribute information and time for briefing. 6. Maintain a database of community needs based on geography, demographics, resiliency center possibilities, existing infrastructure	Same for both: Island wide for both (Pre emergency), evacuation communication, inland vs coastal impacts different (Post)	What to do/where should people go if the community is isolated and unable to access information after a disaster. (e.g., school, churches, plaza)	1. Determine equipment compatibility and necessities for each community/region. 2. Conduct community workshops with community leaders and focus on rural and underserved communities. Re-identify local responders willing to be translators. 3. Evaluate/find existing data (private and public), (identify orgs already doing work in community) 4. Visit communities to document needs and points of contact. Be targeted (e.g., agencies and groups developing message, can plan events such as town hall meetings) and opportunistic (e.g., if community is having an event, use the event to share information). Use an event organized by the community (especially with food and activities)	3	State level, NGOs, local emergency management organizations, faith-based orgs, schools & universities. Academia, NGOs, Community based orgs with established gov/commonwealth/territory partnership for information sharing. Communities/municipalities leaderships (e.g., mayor, elected political officials); grassroots community organizations (e.g., churches). Official message developers (e.g., NWS, FEMA, local emergency management- PREMA, VITEMA). Sea Grant
	Communities relying on social media and not official sources of information	Lack of exposure for official sources, too much exposure for other information	More outreach about what official sources of information are	1. Ensure local agencies have unified message before events. Conduct community outreach on official sources of information, who and how to access official information. 2. Encourage local government support of NWS, teach how the products published by NWS can be interpreted and how to use them. Before each hurricane season, NWS sit down with forecast communicators, consider the use of a certificate to authenticate sources. 3. Teach resource quality. 4. Create official website/social media to document official emergency sources and promote/market the platform (have links back to each resource e.g., NWS). 5. Need to ensure power for and use of: SAT phones, UHF, PA systems, and encourage using phones with low wattage, solar hard drives. Education/outreach campaign on how to use the different technologies/pay for services	Same for both: increase use of tsunami ready guidelines, clarify tsunami warning 'cancellation' vs. 'all clear', WEA	Invest and investigate in technologies; government cannot fund all of it (seek outside grants/funding sources) TV personalities vs NWS (creation of controversy for views), NWS is less entertaining and has to follow protocols vs beliefs. Invite celebrities and influencers to social media trainings	1. Training and education for community members, identify who is capable of conducting education sessions. At the outreach events, teach how to buy, use, and maintain the equipment. Use universities for outside assistance. 2. Develop an outreach team to include: graphic artist, website builder, science communication expert, marketing specialist, social media expert. Messaging should be concise, easy to read, contain critical information at the forefront. Use graphics (avoid large files), lists, various colors and fonts, and simple language (accommodating cultural preferences e.g., English vs. Spanish). 3. Be targeted (e.g., agencies and groups developing message, can plan events such as town hall) and opportunistic (e.g., if community is having an event, use the event to share information). Use an event organized by the community	3	State level (PREMA & VITEMA), academia or other private partners, local level, communities/municipalities leadership (e.g., mayor, elected political officials); grassroots community organizations (e.g., churches). Official message developers (e.g., NWS, FEMA, local emergency management- PREMA, VITEMA). Sea Grant
	Contingency planning for emergency communication	Back up communication routes, diverse ways to request help (e.g., internet not available)	Need more than standard communication (e.g., radio, paper map, ham radio)	1. Encourage folks to get amateur/ham radio license. 2. Preposition sat phones, work with technology companies to develop low tech solutions 3. Conduct training/drills to teach community and make sure technology is working	useful for both situations	encourage regular drills, practices to maintain capabilities	Connect with university/radio clubs. Identify funding source/opportunities. Demonstrations to solicit interest, go to events and set up table. Stories/outreach about why some communities were better off post disaster because had sat phones/ham. Continuing education, training	5 (technical skills and need buy in, might still be problem with sat phone in PR)	Federal communications commission (FCC), ARRL - amateur radio relay league, emergency management agency, amateur radio clubs, local technical university (e.g., electrical engineering)
	Communicate the severity danger/risk	having public understand the risk; people think they are lucky, manage expectations, warning fatigue. "Burn out"- desensitizing of alarms	Because of the size of the island, confidence in the forecast/warning; people get desensitized with many hurricanes missing Puerto Rico; so many warnings with nothing happening, people choose not to respond. Take culture into account when designing communication lines	1. Show damage from previous storms, and consistent messaging each season. 2. Less emotion when messaging, keep message calm to prepare rather than scare community	Same for both		Create traveling exhibit of how things went wrong and why you should be prepared; vivid, be targeted and opportunistic. Creating videos/photo show	2.5	Communities/municipalities leaderships (e.g., mayor, elected political officials); grassroots community organizations (e.g., churches). Official message developers (e.g., NWS, FEMA, local emergency management- PREMA, VITEMA). Sea Grant

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Infrastructure	Lack/enforcement of residential building codes	building codes not enforced, and people did not understand homes were unsafe	More damage and loss of life due to unsafe structures	1. Messaging related to maintaining a safe structure, not exclusively collecting water. 2. Critical infrastructure should be evaluated 3. Properly use federal funds to repair and maintain infrastructure 4. Professional education, assessment of curriculum in all academic settings	Same for both	dept. of transportation	Detailed assessment of critical infrastructure; meeting with engineers/architects in municipalities to go around communities to identify most important aspect of a structure. Different source of funding for public, private and municipal	5	Municipal architects/engineers; FEMA capacity build sector;
	Access to clean water			1. Education on rainwater harvesting, the importance of it. Community workshops on virus protection fitting into cultural norms (list of best practices) 2. Improve residential water collection to maintain a reserve. Encourage rainwater collection/capture with safe treatment. 3. Education on low cost filters (e.g., sand). 4. Education on maintenance of individual water sources. Reduce barriers to home/commercial rainwater capturing. 5. Proper installation of tanks/cisterns. 6. Promote/fix policy for rainwater capture. 7. Investigate/ revise rainwater capture policy (resiliency center example).			1. Educate on proper use of water catchment filtration systems. Educating about how to clean water/maintain system 2. Create document (e.g., one-pager)/demonstration for rainwater harvesting; low cost, implement at a few locations within the community to encourage community members to copy. 3. Create tax incentives to make collection/filtration more widespread. 4. New construction require redundant water systems, existing construction improve collection systems,	Education = 2 Implementation = 3 Policy Change = 5 sliding scale (depends on technology of choice)	Homeowner association, private industry, engineering organizations, academia, government, SME (Small Medium Enterprise) incubators local water company, non-profits, private business, commonwealth/territory/municipality responsible for building codes
		no redundant water for residents/no cisterns	People ran out of water		Same for both				
	Poorly maintained infrastructure	e.g., failure of infrastructure (water); waiting for govt to maintain infrastructure	Empowering communities to take accountability/responsibility of infrastructure	Enforce construction code, certified inspectors, education for empowerment in maintenance solidarity training. 1. Informal contractor training 2. Use best construction/maintenance practices from other hurricane/ prone states and countries	coastal vs island wide (different types but similar problem)	benefit for local may have regional impacts	Create courses and certifications, mandate training. Build cat 4&5 rated buildings and implement best practices for Tsunami resilience	4	Government and engineering organizations, insurance industries, community involvement/participation
Leadership	Leadership and capacity for multiple, simultaneous disasters	Competition for resources. Trained/experienced resources. Turnover of political/experienced/burnout staff. Don't restructure the organization during a disaster	Climate change could lead to stressors to staff/resources/retention. Need local level leaders-educated through trainings. Minimize turnover.	Professionalize emergency management positions, establish/increase emergency management schools, local level leader training. 1. Develop curriculum from vocational schools to higher learning institutions	Same for both		1. Curriculum development (at all levels)	3	Academia & dept. of education
Logistics	Port accessibility limited because of law	San Juan is major port for food/resources coming to PR. Other ports are used for petroleum products, coal.	necessary aid could not be distributed/get to local communities quick enough. Circumvent barriers using emergency declaration to streamline that (e.g., turn off taxation during response.)	1. Landside facilities are geared toward handling only one type of commodity, 2. Require private ports to be capable, and ready to act in the case of a disaster. 3. Identify alternate airports/transportation that would be viable in event of storm 4. Identify laws impeding maritime supplies, and push for them to be temporarily waived (e.g., Jones Act) for appropriate timeframe. 5. Neutral study on Puerto Rico relevant Jones Act Issues related to emergency support	Same for both	The process is there but political realities impede use. Major airport is in splash zone for tsunami. Potential to stage resources	1. conduct study and analyze potential impacts of change 2. Have diverse ports, capable of handling other goods; back-up port for response operations. 3. Policy shift by port authority by diversifying use of port. 4. Update contingency plans to have more than one viable port available.	Study =1 Change = 5	Academia, think-tank port authority, govt of PR, private industry
	Marine/land debris hindered by lack of staging areas and logistics	see Florida plans for an example	need pre-identified staging areas	1. Having a plan for where to put marine debris, 2. destroyed buildings/construction materials, 3. Identify final location for debris (e.g., landfill vs. taking off island)	Same for both	see x-prize winner	1. Identifying locations ahead of time in contingency plans, 2. Encourage use of central drop-off locations for community members to dispose of household hazardous waste (HHW)	1.5-2	FEMA, USCG, local agencies, NOAA Marine Debris, Public Works, EPA
	Land Use Plan	building again in high-hazard area (i.e., schools, hospital, NWS)	we must enforce sensible use of land use plan and zoning; assess on paper but in reality is different (i.e., zoning)	1. Enforce code, consistency in code, implement new code. 2. Approve new land use regulations with strong focus on risk zones.	Same for both		1. Meet with risk experts and planning board to ensure best practices	4	local and state gov., (Permitting agencies, municipalities), community feedback
	Policy guidelines (*PAPPG) need to be revisited due to change and new technology, climate change etc.	Better integrate green technologies, climate change considerations into existing policies for funding and mitigation.	These policies need to be revised before an incident	High-level policy agreement on existing FEMA public assistance, mitigation and recovery policies. Maintain and restore corals and natural infrastructure to protect coastal communities. Simplify FEMA's public assistance program policies for non-traditional natural features	Same for both	Coasts on island are particularly important.	GAO-focus group. Agency feedback to GAO and FEMA. Agencies/academia provide information on how green infrastructure fits into FEMA facilities.	4	Federal agency. Ongoing GAO focus group on Maria. Universities

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Policy	OFAs (other federal agencies) need to be assertive in their supplemental funding request	There are some things FEMA can not fund	You snooze, you lose	Use consistent vocabulary. Agencies should be responsible/aware for their own coverage/vocabulary. Host workshops/training on funding/grant writing/petitions/procurement/opportunities. Include the local emergency coordinators along with the state and mayors at annual meeting for training (not limited to local authority).Training of federal grant submission (preparedness).Improve liaison outreach/communication.	Same for both	This might be unique to Puerto Rico.	Interagency training on procedures of funding opportunities. Create a survey (to commonwealth agencies) to gather post-event lessons learned on supplemental grant processes. Federal agencies aware of supplemental funding opportunities (grant, special project funding) and responsible for requests relative to their mandates. Federal agencies should be prepared with requests to Congress for supplemental funding according to their agency mandates.	3	federal agencies. Commonwealth is unique in that funding budget does not allow for
	Interpersonnel- layers of bureaucracy slowed progress	politics getting in the way of progress	need to identify an authority- in past only identified problem	1. Create checklist to identify tasks for each person, 2. communicate/socialize checklist and responsibilities, 3. hold organizations accountable for responsibilities, 4. share information with managers	Same for both		People need to know their jobs (checklist), communication to avoid different decisions being made, held accountable by making sure people report problems (investigation), teams of public oversight to help. This might not help everyone but it could in the future. Turn over the information to theirs and new leaders (who has that information for when you are gone?)	4	all levels (state municipalities)
	People inadequately prepared for cat. 4 or 5, tsunamis (high impact, low frequency events)	Prior close calls gave a false sense of security & resources were moved to VI to deal with Irma	Should prepare regardless of category level	For *Hurricane* : 1. Involve social scientists, they may be able to help with effective, engaged outreach. 2. Education and buy-in from local community leaders. More effective exercises especially on the items we did wrong previously (i.e., AAR). Use Hurricane Maria as an example and spread lessons learned. Don't let AAR sit on a shelf; reassess. Develop a checklist of activities. 3. Contingency planning to include multiple back-up NWS offices outside of threat zone For *Tsunami:* prepare models and videos of what it would look like (overlay culturally significant places), storm surge water marks / signage (Keep reminders of physical damage), Art projects. Media and education campaign	Both Tsunami = preparing for something you haven't experienced, increased challenge -	ex. In US Storm Ready in Florida has 3 counties, in Puerto Rico there are 78 municipalities under 1 person.	Social science (this is not a technical problem) how we can improve transfer of information. Research the effectiveness of training/translation. Implement NWS Storm Ready. Expand CERT to include specific training to community (i.e., storm surge, flood). Conduct multi-district/municipality exercises. community involved: award competitions for campaign, education outreach all ages involved. Conduct for both hurricane and tsunamis at schools, mass media, higher ed. Institutions	3 to 4	YES (NWS etc.)

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Preparedness	Lack of emergency planning	Starting from family, community, local, regional.	Local level preparedness plan created with central point of information. Need accountability w.r.t. response plans. Pre-emergency planning to include local law enforcement and impartial parties (e.g., NGO, faith based organizations)	1. Aggressive on pre plan: (a) what programs already have a plan in place? (b) create plans for schools, daycare, work, etc., (c) work with existing organizations or program infrastructure/community leaders. 2. Educate the community regarding: (a) necessary supplies, (b) what should they do with supplies, (c) have it ready before the event- bag of supplies, food, water, communication tools, etc.), 3. Conduct community training/perform drills/table top exercises. 4. Use table top exercises to improve plan/make changes. 5. Re-institute CERT program in schools, churches, etc. and use in coordination with neighborhood watch programs (e.g., "next-door" type app). 6. Consider worst case scenarios (e.g., downed communications, limited tools available)	Both Some - hurricane gives family level planning, Tsunami = "save self mindset",	more focus on the lower levels (families, communities, etc.)	knowledge for the local leaders to bring back to their communities (ex. kids can take it home to their families), break up the workshops into regions to allow more people to attend (for different cultures), NOAA office for coastal management. See VITEMA model as a starting point. (2) Outreach- media blitz (ads at the movies, on roads, radios, TV stations, at stores), public and private classes (home improvement stores), youth organizations (boy scouts, girl scouts, etc.), these need to be on how to prepare for these events. Use project based learning platforms, find and edit existing checklists than can be relevant to Puerto Rico and distribute to community members. Create emergency management education program for communities at all levels year-round. Using existing avenues/organized community events to demonstrate how to use a map, why it is important to have freshwater, etc. (3) Goal is to create self-sufficient communities. Put people on the ground in pilot communities (more difficult to implement but more results), share the results! (4) Update contingency plans to include equipment pre-stage locations	3	community levels (school system, community members), NGOs, Universities, media outlets, photo journalist workshops, emergency management agencies, FEMA
	Lack of federal Pre-Scripted Mission Assignments (PSMA)	Minimize duplicity of efforts.	The more prescripted mission assignments, the quicker response activities can commence and provides training opportunities within agencies	1. Review of existing and development of PSMAs. Integrate commonwealth and FEMA prescripted efforts prior to disaster. 2. Conduct more outreach with state/territory/govt level to educate about what they can ask for in terms of mission assignments. 3. Automated PSMAs for approval, signatures. 4. Include mission assignments in training and exercises. 5. Review historical lessons learned to drive future assessments	Same for both		1. Agencies review what they have currently. 2. Agencies develop new ones as appropriate (e.g., funding for and using NOAA SSC's during non-pollution, weather-related deployments). 3. Keep hazard mitigation plan up to date. 4. Educate commonwealth about FEMA missions to determine what can be asked for. FEMA relies on guidance from local govt level. 5. Conduct exercises to review and update PSMAs. Develop checklist for the state to use to make requests. Recommend to GAO? 6. Inform what can be asked for (e.g., guidance document/ lessons learned)	4	Federal Agencies (FEMA), state and local emergency management agencies (e.g., coastal agencies, all encompassing plan), port authorities, schools, local chamber of commerce, private businesses. Commonwealth/local govt (e.g., hazard mitigation office),
	Did not pre-emptively involve private sector	Private sector often has resources it can contribute to response effort- have resources and assets connected at all levels.	Involve private sector during contingency plans. Make the link on how to support municipalities/local organizations (e.g., transportation/ gas/food)	1. Getting to conversation early. 2. Potential for new contracts/prepositioning equipment ahead of time.	Same for both		Multiple companies get hired or one primary contractor with sub-contractors. Advanced contracting initiatives for pre-planned contracts. List for potential companies available if needed pre-,during, post- disaster	sliding scale	private businesses, local govt, contractors
Response	Rapid assessments of damage/debris were critical. Be bold on initial assessment.	Baseline for FEMA to consider funding opportunities.	Areas/communities that had quick assessments made it easier to scope federal funding	1. Establish baseline prior to event for municipalities; 2. Centralized application to collect assessment information for multiple sectors (i.e., communication center); 3. Pre-plan for what we need to do (before and after), include lag time for response operations (why preparedness is so important), be able to grow food, apply for grants to build-in redundant funding; 4. The public can report on their municipalities	both	This goes beyond just FEMA. Post and report storm information i.e., #hurricane Maria (include GPS). Post - Tsunami survey guide is available. Language and culture must be taken into consideration.	1. Assessments, inventory, create culture; 2.Implement #hashtag. Field exercise like CARIBEWAVE. Develop app (see SERT-FL).	3.5	Communities, municipalities, state and , federal (NWS, FEMA).
Inequity	Vulnerable population	disabled/sick/elderly people were stuck in place	don't wait until hospital is impacted to make decisions/hospital need redundant or back up energy sources	1. Census data/demographic data to focus efforts and identified during emergency preparedness planning to create a special needs plan (i.e., assess who is at risk in each town/region). 2. Compliance checks done in low income communities, first. 3. Recommendations for improvements rather than fines. 4. Messages tailored to underserved communities.	Evacuation plan may vary between T and H	Time of day may influence who is present in the community, family plan would identify who is available during the day vs. night.	If municipalities emergency contingency plans don't exist, then develop and identify vulnerable population(s). If they do exist, include in them. Prioritize installation of 100 Watt radios in hospitals, police stations, EMS communication centers, OEM offices around the island	4	census bureau, social services, health and human services, local law enforcement, local emergency response management, planning and development agency